With METALLURGICAL SUPPLEMENT.

The Engineer.

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VOL. CLI.—No. 3928] LONDON: FRIDAY EVENING, APRIL 24, 1931 [PRICE {WITH SUPPLEMENT} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

ENGINEERING LABOUR.

The Commissioners of His Majesty's Works, &c., are prepared to receive separate TENDERS before 11 a.m. on Friday, 8th May, 1931, for the SUPPLY of (A) MECHANICAL, (B) ELECTRICAL ENGINEERING LABOUR in DAYWORK in the :—

(1) Newcastle-on-Tyne District ..... (B) only
(2) Leeds District ..... (A) and (B)
(3) Southampton District ..... (A) and (B)

during the period of three years from the 1st June, 1931.

Forms for Tender, &c., may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1. 6864

Civil Service Commission.

FORTHCOMING EXAMINATION.—PROBATIONARY ASSISTANT ENGINEERS (MALE) in the Engineering Department of the Post Office (20-25 with extension in certain cases).

Regulations and particulars, together with the forms on which applications must be made, will be sent in response to requests (preferably by postcard), addressed to the SECRETARY, Civil Service Commission Burlington-gardens, London, W. 1, GIVING THE TITLE OF THE SITUATION. The latest date for the receipt of application forms is 9th July. 6872

Crystal Palace School of Practical Engineering.

Principal: MAURICE WILSON, M. Inst. C.E.
Vice-Principal: F. C. P. LAWRENCE, M.S.E.

SUMMER TERM COMMENCES on WEDNESDAY, APRIL 29th. 6813

University of London.

A COURSE of FOUR LECTURES on "STEAM RESEARCH IN EUROPE AND IN AMERICA," will be given (in English) by Professor Dr. Ing. MAX JAKOB (Professor of Engineering and Technical Physics in the Physikalische-Technische Reichsanstalt, Berlin), at THE INSTITUTION OF CIVIL ENGINEERS, Great George-street, Westminster, S.W. 1, on THURSDAYS and FRIDAYS, MAY 7th, 8th, 14th and 15th, 1931, at 5.30 p.m. At the first Lecture the chair will be taken by Professor E. G. Coker, D.Sc., F.R.S., M. Inst. C.E. (Member of Council of the Institution of Mechanical Engineers). ADMISSION FREE, WITHOUT TICKET. Lantern illustrations.

S. J. WORSLEY,
Academic Registrar.
6819

Hull Education Committee.

MUNICIPAL TECHNICAL COLLEGE.

Principal: E. P. BATES, M.A.

Mr. Campaign having accepted a Principalship, there is a VACANCY as HEAD of the SENIOR ENGINEERING DEPARTMENT, to commence 1st June or as soon as possible after that date.

Commencing salary £500 per annum, rising by annual increments of £20 to a maximum of £600 per annum.

Consultative work may be undertaken with the approval of the City Council.

Forms of application and further particulars may be obtained from the undersigned on receipt of a stamped addressed foolscap envelope and must be returned so as to reach these offices not later than Saturday, 2nd May, 1931.

R. C. MOORE,
Director of Education.

Education Offices,
Guildhall, Hull,
11th April, 1931. 6854

Administrative County of LONDON.

NORTHERN OUTFALL WORKS.

RECONSTRUCTION OF PIER—WESTERN ARM.

The London County Council invites TENDERS for the EXECUTION of WORKS in connection with the RECONSTRUCTION of the WESTERN ARM of the PIER situated in the Metropolitan Borough of Woolwich, in the County of London, on the north bank of the River Thames, at the Council's Northern Outfall Works, Beckton, London, E. 6.

The works include the demolition of the western arm of the existing timber pier, about 227ft. long and 20ft. wide; reconstructing it in timber, about 235ft. long and 25ft. wide; and the laying of new cast iron mains and steel rail tracks on the reconstructed portion of the pier, and the removal of the existing timber jetty, about 560ft. long and 16ft. wide.

The specification, form of Tender, &c., may be obtained on application to the Chief Engineer, The Old County Hall, Spring-gardens, S.W. 1, upon payment of £10 by cheque, draft or money order to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before payment of the fee.

Remittances by post should be addressed to the Chief Engineer, The Old County Hall, Spring-gardens, S.W. 1. Personal inquiries at Room 2, No. 3, Warwick House-street, Cockspur-street, S.W. 1.

The Contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract, and in "The London County Council Gazette."

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 18th May, 1931, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX,
Clerk of the London County Council.
6889

The Engineer

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PUBLIC NOTICES

Administrative County of LONDON.

The London County Council invites TENDERS for the EXECUTION of the undermentioned WORKS, viz.:—

INSTALLATION of NEW BOILER for Swimming Bath and INCIDENTAL WORKS at Hornchurch Children's Home, Hornchurch, Essex.

The specification, form of Tender, &c., may be obtained on application to the Chief Engineer, The Old County Hall, Spring-gardens, S.W. 1, upon payment of £1 by cheque, draft, or money order to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same.

Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before payment of the fee.

Remittances by post should be addressed to the Chief Engineer, The Old County Hall, Spring-gardens, S.W. 1. Personal inquiries at Room 2, No. 3, Warwick House-street, Cockspur-street, S.W. 1.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in "The London County Council Gazette."

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Tuesday, 5th May, 1931, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX,
Clerk of the London County Council.
6874

Bombay, Baroda and Central INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to Noon on Friday, 8th May, TENDERS for the SUPPLY of :—

WOOD SCREWS, SPLIT PINS, &c.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices, The White Mansion,
91, Petty France, Westminster, S.W. 1,
21st April, 1931. 6872

PUBLIC NOTICES

Borough of Newbury.

WATER DEPARTMENT.

TENDERS are INVITED by the Newbury Corporation for the SUPPLY of :—

(1) VENTURI METER and RECORDING APPARATUS;
(2) ELECTRIC RESERVOIR LEVEL INDICATOR and RECORDER.

Copies of the specification may be obtained on application to Mr. W. H. D. Lester, Consulting Water Engineer, 18, Cheap-street, Newbury.

Tenders, enclosed in an envelope endorsed "Tenders for Recording Apparatus, &c.," should reach the undersigned not later than the 14th May next.

The Corporation do not bind themselves to accept the lowest or any Tender.

S. WIDDICOMBE,
Town Clerk.

Municipal Buildings, Newbury.
21st April, 1931. 6880

Borough of Scarborough.

PROPOSED PREMISES, ARTERIAL ROAD (EAST BLOCK).

WESTBOROUGH TO VICTORIA-ROAD.

The Town Council of Scarborough is prepared to receive TENDERS for the WHOLE OF the following WORK in connection with the above-named proposed BUILDINGS :—

Excavation, Drainage, Reinforced Concrete Retaining Walls, and Foundations for Steel Framing, Brickwork, Plastering, Plumbing and Glazing, Roof Tiling, Joinery and Painting.

Plans, specification and bills of quantities, conditions of contract, &c., can be seen at my office, and form of Tender and bill of quantities obtained on and after Tuesday, the 21st day of April, 1931, upon deposit of £2 2s., to be returned to tenderer if a bona fide Tender is received and bill of quantities returned.

Sealed Tenders, in an envelope provided, to be delivered at the Town Hall, Scarborough, not later than Noon on Monday, the 4th day of May, 1931.

The Council do not bind themselves to accept the lowest or any Tender.

HARRY W. SMITH, A.M.I.C.E.,
Borough Engineer.

Town Hall, Scarborough,
17th April, 1931. 6870

PUBLIC NOTICES

County of London.

The London County Council invites TENDERS for the PURCHASE, DISMANTLING and REMOVAL of ONE 5000-KW TURBO-ALTERNATOR with CONDENSING PLANT, &c., at present installed in the Tramways Power Station at East Greenwich.

Particulars and form of Tender may be obtained from the General Manager of Tramways, 23, Belvedere road, S.E. 1, who will also give facilities for the plant to be inspected between the hours of 9 a.m. and 5 p.m. on any weekday except Saturday.

Tenders must be delivered to the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, not later than 4 p.m. on Monday, 11th May, 1931.

The Council does not bind itself to accept the highest or any Tender.

MONTAGU H. COX,
Clerk of the London County Council.
6885

Great Western Railway.

The Directors of this Company are prepared to receive TENDERS for WIDENING the MAIN LINE between their South Wales Junction and the Bridge over the Floating Harbour at Bristol.

Plans may be seen and forms of Tender, specification and bills of quantities obtained at the office of the Engineer at Paddington Station, between the hours of 10 a.m. and 4 p.m. on payment of Two Guineas, which will be returned to bona fide tenderers.

Tenders, addressed to the undersigned and marked outside "Tender for Widening at Bristol," will be received not later than 10 a.m. on Thursday, the 14th proximo.

The Directors do not bind themselves to accept the lowest or any Tender.

F. R. E. DAVIS, Secy.

Paddington Station, London,
20th April, 1931. 6881

Leeds Corporation Waterworks DEPARTMENT.

CONTRACT NO. 274.

The Waterworks Committee of the Leeds City Council invite TENDERS for the PROVISION, ERECTION and MAINTENANCE of an ELECTRICALLY DRIVEN MULTI-STAGE TURBINE PUMP (capacity 2084 gallons per minute), complete with MOTOR, SWITCHGEAR, STARTER, &c.

Particulars of the proposed Plant, including instructions as to the delivery of Tenders, may be obtained from the undersigned.

The Waterworks Committee does not bind itself to accept the lowest or any Tender.

HARRY SHORTREED,
Waterworks Manager.

26, Great George-street, Leeds,
20th April, 1931. 6871

Rhyl Urban District Council.

RHYL SEWERAGE.
PUMPING MACHINERY.
TO MANUFACTURERS OF ELECTRIC MOTORS AND CENTRIFUGAL PUMPS.

The Rhyl Urban District Council invite TENDERS for the MANUFACTURE, DELIVERY, ERECTION and SETTING TO WORK, at their existing Pumping Station at Rhyl, of THREE UNITS of PUMPING MACHINERY to lift sewage at the rate of 5500, 1400, and 800 gallons per minute respectively, against a static head of 30ft.; and TWO UNITS at their proposed Pumping Station, also at Rhyl, each capable of lifting sewage at the rate of 300 gallons per minute against a static head of 18ft.; also for a 14ft. diameter REVOLVING SEWAGE SCREEN and INCIDENTAL WORKS in connection therewith, in accordance with the specification, quantities and drawing prepared by their Consulting Engineer, Mr. Robert Green, M. Inst. C.E., 37, Bennett's-hill, Birmingham, from whom copies can be obtained on and after Monday, the 27th instant, upon the deposit of £3 3s., by cheque, which will be returned only to manufacturers who submit a Tender not subsequently withdrawn.

These documents will be issued only to bona fide manufacturers having their works in Great Britain.

Sealed Tenders, addressed to the undersigned, to be delivered before 30th May, 1931.

The Council does not bind itself to accept the lowest or any Tender submitted.

T. AMOS JONES,
Clerk to the Council.

Council Offices, Rhyl. 6879

St. Pancras Borough Council.

TO BOILERMAKERS.

The Council invite TENDERS for a CORNISH BOILER. Copy of specification and form of Tender may be obtained from the undersigned. Tenders are to be forwarded, endorsed "Tender for Baths Boiler," by Twelve o'clock Noon on Thursday, 7th May, 1931.

The Council will not bind themselves to accept the lowest or any Tender.

A. POWELL COKE,
Town Clerk.

St. Pancras Town Hall,
Pancras-road, N.W. 1. 6810

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CORRECTION.

Edward Bennis and Co., Ltd., of 28, Victoria Street, Westminster, London, S.W. 1.

An advertisement appeared in our issue of March 27th, 1931, in which the dimensions of the Lancashire Boiler were given as 8′ 0″ × 60′ 0″. This, of course, was an error, and we are requested to draw the attention of our readers to the fact that the dimensions should have been 8′ 0″ × 30′ 0″.

PUBLIC NOTICES

Metropolitan Water Board.

TENDERS FOR THE SUPPLY OF STORES, &c.

The Metropolitan Water Board invite TENDERS for the SUPPLY of the undermentioned STORES and SERVICES, &c., for periods of 6 and 12 months, commencing 1st June, 1931 :—

Tender No.
1 Bricks, Fire-bricks, Cement, &c.
8 Iron and Steel.
9 Bolts and Nuts, Screws, Files, Shovels, Steam Tubes, &c.
12 Fuel Oil, Oils (Lubricating), Kerosene, Motor Spirit, Greases, Tallow, &c.
19 Iron, Brass, Gun-metal, and other Castings.
20 G.M. Stop Cocks and Ferrules, Outlets and Caps for Fire Hydrants.
22 Timber.
23 Maintenance of Weighing Machines.

Tenders must be submitted on the official forms, which may be obtained from the Chief Engineer by personal application at the offices of the Board (Room 155) or upon forwarding a stamped addressed sack envelope.

Applicants should refer to the number of the Tender for which forms are required.

Tenders, enclosed in sealed envelopes, addressed to "The Clerk of the Board" and endorsed in the manner indicated in the form of Tender, must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Monday, 11th May, 1931.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1.
18th April, 1931. 6875

South Indian Railway Company, Limited.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

1. SHEFFIELD TOOLS, &c.
2. HELICAL and VOLUTE SPRINGS.
3. WOOD HANDLES.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Sheffield Tools, &c.," or as the case may be, with the name of the firm tendering, must be left with the undersigned not later than Twelve Noon on Friday, the 8th May, 1931.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 5s. for each copy of the Specifications Nos. 1 and 2, and of 2s. 6d. for each copy of Specification No. 3.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.
91, Petty France, Westminster, S.W. 1,
22nd April, 1931. 6820

Egyptian Government.

APPOINTMENT OF A CARRIAGE WORKS MANAGER.

APPLICATIONS are INVITED for APPOINTMENT as a CARRIAGE WORKS MANAGER in the Mechanical Department of the Egyptian State Railways, Telegraphs, and Telephones Administration.

Applicants must be of British nationality, between 30 and 40 years of age, and possess the following qualifications :—

Must be fully qualified Mechanical Engineer, either holding an Engineering Degree from a recognised Engineering College, or be an Associate or Full Member of the Institution of Mechanical Engineers, England.

Must have served a regular pupilage or apprenticeship of at least 3 years' duration in a Mechanical Engineering Works of repute, preferably in the Workshops of the Locomotive, Carriage and Wagon Department of a leading English Railway.

Must have held an executive position in a Railway Carriage Workshop and be thoroughly up to date in matters relative to Carriage and Wagon Construction and Materials used therein, both for Timber-built Bodies and Vehicles of All-steel Construction. The latter qualification is essential.

Must have a good knowledge of Woodworking Machinery and of the various kinds of Timber used in Railway Carriage Construction and Finishings, together with a good working knowledge of Paints and Varnishes and their practical application.

Must be conversant with the preparation of estimates and costs and with piece-rate fixing.

Full details of experience under each of the above headings must be given.

Salary £E1000 per annum. To be increased after two years to £E1080 (£E1 equals £1 0s. 6d. approximately), free of Egyptian income tax.

The appointment is subject to medical examination and approval of the Authorities in Egypt.

The selected candidate will be granted a transfer allowance equal to one month's salary for change of residence from England to Egypt and vice versa.

Period of contract three years.

Third-class fares and reasonable out-of-pocket expenses will be paid to applicants who are requested to attend for interview and/or medical examination.

Application and specimen contract forms may be obtained from :—

THE CHIEF INSPECTING ENGINEER,
Egyptian Government,
41, Tothill-street, London, S.W. 1,

to whom they should be returned, with full particulars as to education, qualifications, previous experience, personal references and COPIES of certificates or testimonials.

Envelopes to be inscribed "Carriage Works Manager." 6869

Egyptian Government.

APPOINTMENT OF LOCOMOTIVE DRAUGHTSMAN.

APPLICATIONS are INVITED for APPOINTMENT as LOCOMOTIVE DRAUGHTSMAN in the Mechanical Department, Egyptian State Railways, Telegraphs and Telephones Administration.

Applicants must be of British nationality and possess the following qualifications :—

Must have been employed as fully qualified Draughtsman in a Locomotive Drawing-office of a first-class Railway and have had practical experience of at least 5 years in a Locomotive Builder's Workshop ; a knowledge of Carriage and Wagon Designing is an additional asset.

The duties will be to take charge of detail work in the preparation of complete drawings of locomotives, watching necessary calculations and should also be a capable designer.

Salary £E420 per annum (£E1 equals £1 0s. 6d. approximately), free of Egyptian income tax.

The appointment is subject to medical examination and approval of the Authorities in Egypt.

The selected candidate will be granted a transfer allowance equal to one month's salary for change of residence from England to Egypt and also vice versa.

Initial period of contract three years.

Third-class fares and reasonable out-of-pocket expenses will be paid to applicants who are requested to attend for interview and/or medical examination.

Application and specimen contract forms may be obtained from the

CHIEF INSPECTING ENGINEER,
Egyptian Government,
41, Tothill-street, London, S.W. 1,

to whom they should be returned with full particulars as to education, qualifications, previous experience, personal references and COPIES of certificates or testimonials.

Envelopes to be inscribed "Locomotive Draughtsman." 6865

BLACKIE & SON, LTD.

Just Published.

THE HIGH-SPEED INTERNAL-COMBUSTION ENGINE

By HARRY R. RICARDO, F.R.S.,
Gold Medallist of the North-East Coast Institution of Engineers and Shipbuilders,
Silver Medallist of the Royal Aeronautical Society.

With 292 figures and half-tones. Price 30s. net.

This is a revised and extended edition of Volume II. of *The Internal-Combustion Engine* published in 1923. It deals more particularly with the light, high-speed, mobile types such as are used for aircraft, motor vehicles, heavy transport, &c., and contains a new chapter on the high-speed Diesel engine.

THE ELEMENTARY THEORY OF THE INTERNAL-COMBUSTION ENGINE

By F. W. LUDLAM, B.Sc. Eng. (Lond.),
Engineering Science and Mathematical Master, Falmouth Technical School.

Price 3s. 6d. net.

Engineering apprentices and others commencing a serious study of the internal-combustion engine frequently encounter much difficulty in the theoretical chapters of advanced textbooks. It is for such students, often none too well equipped mathematically, that this book is intended.

STEAM CONDENSING PLANT. In Theory and Practice. By JAMES SIM, B.Sc. Eng. (Lond.), Chief Designer, Condenser Department, Messrs. G. and J. Weir, Ltd., Engineers, Cathcart, Glasgow. With 142 figures and half-tone illustrations. Second Impression. **18s. 6d. net.**

MODERN RAILWAY SIGNALLING. By M. G. TWEEDIE, A.M.I.E.E., M.I.R.S.E., and T. S. LASCELLES, M.I.R.S.E. With 291 figures half-tone illustrations. Third Impression. **20s. net.**

APPLIED HEAT. Adapted from *Der Warmeingenieur* by Dipl.-Ing. JULIUS OELSCHLÄGER, Chief Engineer, Wismar, Member of the Municipal Board of Works. Under the Editorship of H. Moss, D.Sc. (Lond.) A.R.C.S., D.I.C., Imperial College of Science and Technology. With 270 figures. **30s. net.**

Full particulars of the above and catalogue of Advanced Scientific and Technical Books on application

BLACKIE AND SON LIMITED

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BLACKIE & SON (INDIA) LTD., WARWICK HOUSE, BOMBAY
BLACKIE & SON (CANADA) LTD., 1118 BAY STREET, TORONTO. 5

PUBLIC NOTICES

Municipality of George Town, PENANG, STRAITS SETTLEMENTS.

ADVERTISEMENT.

ASSISTANT ENGINEER REQUIRED by the Municipal Commissioners of Penang for the permanent staff of their Municipal Engineer's Department, the appointment being, in the first instance, on a three years' agreement.

Age 23 to 25 years, unmarried. Applicants must have received a good technical education and have served a regular training as pupil and assistant in a Municipal or County Engineer's office, and must possess experience in Municipal and General Engineering Work, including roads, buildings, bridges, sewerage and conservancy work, and the control of workmen. Preference will be given to candidates who have passed the Testamur Examination of the Institution of Municipal and County Engineers.

Salary 4800 dollars, 5100 dollars, 5400 dollars for the three years of the agreement and rising thereafter (if service be continued) in accordance with the Commissioners' Salary Scheme. There is at present a temporary allowance of 10 per cent. on the salary for unmarried men. The exchange value of the dollar is 2s. 4d. sterling, at which rate the salary for the first year including the temporary allowance would amount to £616. There is at present no income tax.

Strict medical examination.

Free passage with half salary during the voyage out. Transport allowance of 100 dollars per month for maintenance of a motor car.

Liberal Provident Fund.

Eight months' leave, with full pay, is normally granted after four years' service.

Penang is one of the beauty spots of the Eastern world. George Town is situated on the coast within 3 miles of the Penang Hills Railway, which runs up to the Hill Station, 2400ft. above sea level. There are excellent facilities for swimming, riding, golf, tennis, cricket, and all usual games. The population of George Town is 134,000, and day temperature about 80 deg. to 90 deg. F.

Applications, stating age and birthplace, and confirming that candidate is unmarried, also giving details of education, training and experience generally, and referring particularly to the qualifications mentioned above, and accompanied by copies (not originals) of testimonials, to be lodged with Messrs. PEIRCE and WILLIAMS, MM. Inst. C.E., 1, Victoria-street, London, S.W. 1, Agents for the Commissioners, not later than Monday, 4th May, 1931.

Further particulars, if desired can be obtained from the Agents. 6866

Two Temporary Technical

ASSISTANTS, preferably under 30 years of age, REQUIRED by L.C.C. in the Fire Brigade for Inspectorial Duties in connection with Fire and Safety Matters in certain Buildings.

Applicants must produce satisfactory evidence of experience in Electrical Engineering (installation work) and Building Surveying.

Commencing rate of pay not exceeding £5 10s. a week, according to qualifications.

Applications, including full particulars, should be made by letter only and addressed to the CHIEF OFFICER, London Fire Brigade Headquarters, Southwark Bridge-road, S.E. 1. Canvassing disqualifies. 6856

Wakefield Corporation Waterworks.

TEMPORARY JUNIOR ENGINEERING ASSISTANT REQUIRED for about one year. University training essential. Salary on scale, £130 per annum at age 21 to £225 per annum at age 27, according to age.

Applications, stating age, qualifications, experience (if any), accompanied by copies of two testimonials, to be sent to C. CLEMESHA SMITH, M. Inst. C.E., Town Hall, Wakefield, on or before 11th May, 1931. 6811

PUBLIC NOTICES

The Hartlepool Gas and Water Company.

APPOINTMENT OF RESIDENT ENGINEER.

The Company REQUIRE the SERVICES of a RESIDENT ENGINEER to Take Charge of the Construction of an Impounding Reservoir and Ancillary Works in the neighbourhood of West Hartlepool.

The reservoir will be formed by an earthwork embankment with puddle core, and it will be a recommendation if an applicant has had actual experience on work of this class.

Applicants must be fully conversant with and thoroughly experienced in the duties of a Resident Engineer in charge of public works carried out by contract.

The appointment will be for the period of construction (subject to satisfactory service), which it is estimated will be between three and three and a-half years.

The person appointed will be required to act under the direction of the Company's Consulting Engineers.

Salary £500 per annum.

Applications, stating age, qualifications, experience (in detail) and present employment, together with copies of not more than three recent testimonials, and endorsed "Appointment of Resident Engineer," should be delivered to me at the Company's Offices, West Hartlepool, not later than first post on Thursday, 7th May, 1931.

J. R. BRADSHAW,
Engineer, Manager and Secretary, Hartlepool Gas and Water Company, West Hartlepool.
15th April, 1931. 6867

LAND DRAINAGE ACT, 1930.

The River Medway Catchment Board.

APPOINTMENT OF ENGINEER.

The River Medway Catchment Board invite APPLICATIONS for the APPOINTMENT of ENGINEER to the Board from qualified Engineers with experience in River (tidal and non-tidal), Embankment and Sea Defence Works.

The salary will be £700 per annum, rising by annual increments of £50 to a maximum of £900 per annum, together with travelling allowances. Office accommodation will be provided in Maidstone.

The candidate appointed to the office will be required to take up the duties immediately and to give the whole of his time to the duties of the office.

Application must be made on a form (obtainable from the undersigned on receipt of a stamped and addressed foolscap envelope), which must reach the undersigned not later than 1st MAY, 1931.

Canvassing in any form will be considered a disqualification.

Selected candidates will be required to forward twenty-five copies of their applications and testimonials for circulation to members of the Board.

P. W. COX,
Acting Clerk.
Sessions House,
Maidstone. 6853

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, an ENGINEER as REPRESENTATIVE for sale of Engineering specialities ; good position and remuneration offered to suitable man who would invest from £500 to £1000 in business, which would be secured.
Address, 6861, The Engineer Office. 6861 A

ASSISTANT to SALES DIRECTOR WANTED for Engineering Company, London. Good education, some knowledge of engineering and experience of sales organisation. Age 30-35. Testimonials not required with applications, which should state experience and salary required.—Address, P1004, The Engineer Office. P1004 A

SITUATIONS OPEN (continued)

WANTED, MECHANICAL ENGINEER, with first-class theoretical education and practical experience to Supervise the Mechanical and Electrical Installations, as well as Tooling Equipment of a Large Modern Plant working on Mass Production ; located in the North of France.

French language thoroughly essential and English very desirable.

Good prospects for advancement in large organisation.

Address, 6815, The Engineer Office. 6815 A

ENGINEER REQUIRED for a Large Textile Works in Lancashire, to Take Charge of Repair and Maintenance Work, Steam Raising and Electrical Driving. Previous textile experience not essential if first-class engineering qualifications. Applicant must be a good disciplinarian and able to delegate his duties. Good prospects. Replies, which will be regarded as confidential, should state age, experience, and salary required.—Write, Box 124, c/o Judd's, 47, Gresham-street, E.C. 2. 6876 A

OLD-ESTABLISHED FIRM of Engineering Contractors have OPENING for ENGINEER-DRAUGHTSMAN to undertake Design and Layout of Storage, Conveying and Handling Schemes, more particularly in Foundries. Qualifications required are : (1) Foundry knowledge and experience ; (2) actual responsible commercial experience over a number of years in the Design and Manufacture of Plant as above. Applications, to be considered, must give full particulars of age, qualifications, experience and salary required.
Address, P1013, The Engineer Office. P1013 A

WORKS MANAGER, with Some Sales Experience, for Engineering Firm in the Midlands, producing Quarry Plant, now employing about 150 men. Plans in hand for rapid expansion. Age about 30 Salary commencing £475.—Address, 6817, The Engineer Office. 6817 A

DETAILING DRAUGHTSMEN REQUIRED by Constructional Engineering Firm in London, with previous experience in similar capacity. Applicants must be conversant with L.C.C. Building Acts and should preferable have had London experience. Full particulars, giving age, salary and experience in confidence.—Address, 6812, The Engineer Office. 6812 A

DRAUGHTSMAN CALCULATOR REQUIRED ; must be capable of making stress and bending moment diagrams and be quick at figures. Applicants must give full information and state salary required.—Address, 6883, The Engineer Office. 6883 A

DRAUGHTSMAN WANTED. Experience in Iron and Steel Works' practice essential. State age, experience and salary required.—Address, 6814, The Engineer Office. 6814 A

DRAUGHTSMAN WANTED for Country Works, preferably accustomed to Design and Manufacture of Electrically Driven Winders, Hoists and Haulage Gears.—Address, stating particulars of experience, age and salary required, P992, The Engineer Office. P992 A

WANTED, MACHINE SHOP FOREMAN, Used to General Work in Cast Iron and Steel, experienced in all modern methods of Machining and Assembly.

Must be used to controlling men and rate fixing.

Age about 35 to 40.

State salary required and send copies of references.
Address, 6853, The Engineer Office. 6853 A

SITUATIONS WANTED

A.M.I. MECH. E., Thoroughly Keen Reliable Man, age 29, DESIRES POST as ASSISTANT to competent and qualified Engineer in London or Home Counties. Advertiser has first-class practical and theoretical training (3 years college)—medallist—is at present holding position of responsibility in general engineers, but ambition demands change. Present salary £320 p.a. Greater scope rather than increase of salary required.
Address, 6887, The Engineer Office. 6887 B

DIPLOMA ENGINEER, Graduated Vienna, with practical experience in first-class German Machine Tool Works, fluent German and French and knowledge English language, OFFERS SERVICE at low remuneration. English references can be supplied.

Answers sub. "Ingineer Nr. 1269." to M. DUKES, Nachf. A.G. Vienna 1/1, Austria. P1003 B

ENGINEER (Public School). Age 50, Designer, exceptional inventive ability, SEEKS POSITION developing new patent or position of trust. Wide experience, trustworthy. Excellent references.—Address, P1016, The Engineer Office. P1016 B

EXPERIENCED ORGANISER REQUIRES POST, capable of taking entire management, production, piecework or bonus rate-fixing, control of all labour, expert costs and work accountancy by clerical or mechanical methods, stores control, sales, etc. Advertiser is middle-aged and can show excellent past records, and is accustomed to the electrical, agricultural, motor and general engineering. Moderate salary only.—Address, P1014, The Engineer Office. P1014 B

GENTLEMAN (36), Chief Buyer and Stores Supt. to large engineering works, wide knowledge commercial practice, cost accounting, factory organisation, REQUIRES EXECUTIVE APPOINTMENT or would undertake representation. Highest credentials.—Address, P1007, The Engineer Office. P1007 B

LATE CHIEF ENGINEER, Copper Mine (34), RE-QUIRES POST, home or abroad. Qualifications, chiefs B.O.T., steam and motor, and South African Mech. Engrs. Certificates. Wide experience all types Diesels and marine machinery, D.C. power station, mining plant ; good draughtsman. Excellent references.—ADVERTISER, 47, Gloucester-road, Cheltenham. 6888 B

MECHANICAL-ELECTRICAL ENGINEER, Age 35, twenty years' experience at home and abroad, SEEKS PROGRESSIVE POST. Experience covers a wide field and includes manufacture, layout, inspection and erection of plant ; consulting and sales engineering. Sound knowledge of French, German and Russian.—Address, P1011, The Engineer Office. P1011 B

MECHANICAL ENGINEER, 29, B.Sc., M.I.E.S., at present ass. manager and desiring change, SEEKS RESPONSIBLE POSITION, home or abroad.

Three years' works, 8 years' D.O., also commercial experience.

Good knowledge modern production methods. Used to responsibility.
Address, P1015, The Engineer Office. P1015 B

PLANT REORGANISATION. — Civil - Mechanical ENGINEER, M.I. Struct. E., M.I. Prod. E., with unique up-to-date experience of plant lay-out, design and equipment for mass production, in U.S.A., England and Continent, SEEKS CHANGE, permanent or advisory capacity ; would also like consider partnership.—Address, P979, The Engineer Office. P979 B

For continuation of Small Advertisements see page 4.

A Seven-Day Journal

The French Commercial Treaty.

AN event of considerable interest is the announcement, made on Sunday last, that Monsieur Elbel, of the French Ministry of Commerce and director of commercial agreements, accompanied by an official of the Ministry of Foreign Affairs, is visiting London with the object of investigating means of carrying out a new treaty of commerce between Great Britain and France. The negotiations really began some months ago, when the Board of Trade requested France to grant facilities for the importation of textiles and certain other products. The French responded by asking what Great Britain had to offer in return. It appeared that Great Britain had nothing to offer, and the matter was allowed to drop. Since then many things have happened. France has been drawn into the world vortex of industrial depression. Her foreign exchanges are rapidly declining, and she now finds that her best customer is preparing to raise a defensive barrier of tariffs. What for many long years the British Chamber of Commerce in Paris was unable to do in face of the French force of inertia is being accomplished by the fear that France is losing her most valuable customer. In view of the growth of protectionist feeling in this country, Great Britain has now something to offer in return for commercial advantages. Even this might not have induced the French Government to take the initiative for a treaty of commerce in place of the existing one, which dates from 1882, if it were not for the urgent necessity of obtaining British support to the new plan which the Government is preparing for a European economic organisation in opposition to the German scheme. It is a diplomatic move which is intended to bring the British on to the side of the French. The matter is an extremely delicate one, and the interests of France will lie more particularly in offering preference to British coal and raw, or partly manufactured, material generally. The repercussion on British engineering industries will, therefore, have to be watched closely.

Dredging Southampton Harbour and the Approach Channel.

WORK is to be begun early in May on a large dredging scheme for Southampton Harbour and the approach channel, the contract for which was recently placed by the Southampton Harbour Board with the James Dredging, Towage and Transport Company, Ltd., of that port. The estimated cost of the work is close upon a quarter of a million pounds, of which £180,000 will be entirely borne by the Harbour Board and £60,000 equally by the Southern Railway Company and the Harbour Board for areas outside the jurisdiction of the Board. The work is expected to extend over five years, and its aim will be to provide a large navigation channel from the sea, through the Solent, right up to the docks. The bottom width of the channel is to be not less than 1000ft., with a depth of not less than 35ft. L.W.O.S.T. inside the Board's area, and of not less than 38ft. in the approach areas. Widening and deepening in the Board's area will take place at Hythe Knock, Netley Shoal, and Calshot, and a commencement will be made in the Thorn Knoll and Western Approach areas. The areas beyond these points are not under the jurisdiction of the Harbour Board, but are dealt with by the Admiralty and Trinity House. Quite recently, having in mind the grounding of three liners in a period of a few weeks, representations have been made by Southampton shipping companies with a view to improving the signalling and navigational facilities, particularly in hazy and foggy weather.

Home-Grown Pit Props.

THERE has just been issued by H.M. Stationery Office, a bulletin of the Department of Scientific and Industrial Research on the suitability of home-grown timber for service as pit props. We have, of course, been in the habit of going to the Baltic, or to France, for pit props, and although some efforts have been made to introduce home-grown timber, they have not been very successful, the mine owners saying that the native wood is not so reliable or convenient. As a consequence, the Forest Products Research Laboratory has investigated the matter and gives its findings in the bulletin just mentioned. Props of various kinds of wood from several districts in England and Scotland were studied, both in the laboratory and on a full-sized scale in a Welsh pit. The general inference is that if home-grown props were more carefully prepared and put on the market in reasonable quantities, they would be as satisfactory as those imported. The cost of rail transport is, however, a handicap to the native timber. The bulletin gives details of the tests carried out, together with some hints on the seasoning and preparation of the props. An interesting situation has arisen with regard to Swedish pit props. Some time ago the Swedish Crown Lands Authorities requested the State Railways Board to endeavour to favour coal purchase from those British collieries which would undertake to use Swedish pit props. [The Board in its reply recently stated that it was unable to accede to such a demand, first on the ground that British coal was one kroner per ton dearer than Polish coal, with the result that recent purchases had fallen from 435,000 tons in 1929 to 130,000 in 1930, and secondly, that the transport of pit props was only a very small item, from 35,000 to 48,000 tons per annum, which was carried at a reduced rate, giving a bare profit. It seems very unlikely therefore that any reciprocal arrangement will be come to.

The New Cunard Liner.

ACCORDING to information which is given in the recently issued *Cunard News Sheet*, it seems to be highly probable that the launching date of the new liner under construction at John Brown's Clydebank yard will be advanced from June, 1932, to February of that year. Very good progress is being made with the construction of the hull, and last week the rudder forging, which weighs more than 150 tons, was despatched from the works of Darlington Forge, Ltd., by road to Clydebank. The new liner, it may be recalled, is to have a length of 1018ft., with a beam of 115ft. There will be eight decks above the water line, the boat deck with a length of 650ft. being 70ft. above the load line, while the promenade deck will be over 720ft. long. The three funnels of the ship are to have a width of 40ft. and they will rise to a height of about 130ft. above the water line. It is stated that the dining saloon, which will be placed between the second and third funnels, is to be the largest room in any ocean liner. The work on the quadruple-screw geared turbine machinery and boilers is proceeding satisfactorily, and orders have recently been placed for the auxiliary generating plant, which will be supplied by the British Thomson-Houston Company, Ltd., and the refrigerating plant, which is to be constructed by J. and E. Hall, Ltd., of Dartford, Kent. The anticipated speed of the vessel is 30 knots at least.

Expenditure on Road and Bridge Schemes.

DURING the month of March schemes for widening, reconstruction and other improvements of classified roads and bridges and for the construction of new roads and bridges of classification value, involving a total estimated expenditure of approximately £5,782,000, were formally approved for road fund grants, and work should be commenced at an early date. These schemes form part of the Government's programme of economic works for the stimulation of employment. The total value of schemes for improvement of classified roads and bridges definitely approved for commencement by the present Government is now £36,000,000, whilst further schemes of the value of £20,000,000 have been approved in principle. Financial assistance has also been indicated towards work on unclassified roads and bridges in various counties and county boroughs, the total estimated expenditure being approximately £122,000.

A Bridge over the Forth.

A MEMORANDUM containing a new proposal for the construction of a road bridge over the Forth has been sent by the Town Clerk of Edinburgh to the Ministry of Transport. It is suggested that the new link should be built 2½ miles west of the present railway bridge, and be approached on the south by the projected Queensferry and Boness road, whilst on the north connection would be made with Rosyth Dockyard. The memorandum states that the Queensferry site for the bridge, of which mention was made in this journal on March 27th, was considered the most suitable because the channel is narrowest at that point, the width being about one mile. But since the depth is considerably greater than at the site proposed in the new scheme, the finding of foundations would be more difficult and more expensive. Moreover, owing to the demands of shipping, a bridge at Queensferry would have to be built at a high level, and it is claimed that facing, as it does, a sort of funnel, wind velocities are higher at that site than at any other part of the estuary. It is estimated that the Queensferry bridge would cost £6,000,000, whereas that suggested in the new proposal would cost only about £2,750,000. The cost of building the newly proposed bridge would be reduced by about £1,000,000, owing to the fact that Rosyth Dockyard could be utilised by the contractors. This saving accounts largely for the disparity in the estimated costs of the two proposed bridges.

Telephone Development.

ON Tuesday, April 21st, the Postmaster-General asked the Government to provide capital to the extent of £32,000,000 to meet the requirements of the Post Office during the next few years. It was estimated, he explained, that the department had between £1,500,000 and £2,000,000 in hand, so that the provision of capital was really at the rate of a little more than £11,000,000 a year. Of the £32,000,000 asked for, all but £2,800,000 was needed for the expanding telephone service. In five years the number of subscribers had increased from 1,390,000 to 1,802,000. The increase in rural exchanges had been very great. The total number of those exchanges was 3366, and since 1929, 444 rural exchanges had been opened, whilst in the same period 9000 call offices had been opened. It had to be admitted that the rural business resulted in a loss. There were very few rural exchanges which showed anything near the fifty subscribers, which was about the number that made for financial equilibrium, and an increase of subscribers in the areas where the exchanges were not fully provided with customers would make a big financial difference. The same applied to other exchanges. An increase in the calling rate was also desirable, but that again was largely a matter of popularising the telephone, and a great deal remained to be done in that direction. The calling rate had been going down, but that was largely because the Post Office had been taking in the rural exchanges, and it was looking to the rural localities eventually to justify the very large amount of capital which had been devoted to telephone development in those parts.

Flying Boats for the Empire Mail.

ON Monday last, Imperial Airways invited a number of guests to inspect at the Rochester Seaplane Works of Short Brothers, Ltd., the three new four-engined flying boats which have been specially designed and built for the Mediterranean section of the India and South Africa mail service. One of these boats has recently passed its acceptance trials, and, with the other two, will shortly be placed in commission. The boats, which are of the "Kent" class, have been named the "Scipio," "Sylvanus," and "Satyrus," and will replace the "Calcutta" type boats now in the Mediterranean service, which will be transferred to the Khartoum–Great Lakes section of the African airway. As recorded in our issue of January 9th, the new boats have a maximum speed of 132 miles per hour, and a cruising speed of 100 miles per hour. The four engines have a designed full-power output of 555 B.H.P. each, which they develop at a height of about 5500ft. Arrangements are made to carry fifteen passengers, a crew of three, and about 3550 lb. of mails, baggage, and equipment, which, with 12,410 lb. of petrol and oil, gives a fully laden weight for the machine of 30,310 lb. The wing span is 113ft., and the passengers' compartment with its seats arranged in four rows of four abreast, has a length of 14ft., with a height of 6ft. 6in. and a width of 8ft. 9in., and it is furnished with large rectangular-shaped windows. Unfortunately, at the time of the inspection the northerly wind did not favour a trial flight, thereby depriving those present of seeing the machines take off, which, in the least favourable conditions, they are reported to do in only 18 sec.

Wireless Receivers.

INVESTIGATIONS made by the German authorities show that only 15 per cent. of the wireless receiving sets in use in that country are crystal sets. Figures from Denmark indicate that a similar state of affairs exists there, for only 10 per cent. of the Danish listeners favour crystal reception. The German investigations also show that 53 per cent. of the valve receivers are fed with current from batteries, 35 per cent. from A.C. mains, and 12 per cent. from D.C. mains. Although no statistics of this nature have been compiled in Great Britain, it is pretty safe to assume that the number of people now using crystal receivers is very small as compared with the number using valve receivers. In view of the strong signals which are now available from transmitting stations, the rapid decline in the use of crystal receivers is somewhat remarkable, but in view of the fact that the object of the British regional distribution scheme is to provide alternative programmes for listeners on the most simple class of receiver, the use of the crystal may increase when that scheme is completed.

The Railways and Road Transport.

DURING a hearing before the Traffic Commissioners for the North-Western Area in the Town Hall at Manchester on April 21st, some interesting evidence was put forward by Mr. Ashton Davies, general superintendent of the London, Midland and Scottish passenger commercial division, when citing the company's objections to the proposal that the Manchester Corporation should run a motor omnibus service between Gatley, Manchester, and Norden. His company, he said, did not object to purely local services, but believed that the new proposal would lead to wasteful competition. The total receipts for the L.M.S. in the Manchester commercial division had decreased from £10,758,640 in 1924 to £7,845,072 in 1930. The reduction in receipts was due to road competition. Figures were put forward showing how the reduction had proceeded gradually since 1924, not only for the Manchester division, but also for the whole system. Mr. Davies pointed out that the real trouble in the Manchester area was caused by the fact that the local Corporations were seeking to form express town-to-town omnibus services—a kind of traffic which the railways created and should hold. He added that 93 per cent. of the passengers carried on the L.M.S. travelled at 1d. a mile, and only 7 per cent. at the standard fares, but in spite of these reductions in fares, traffic continued to decrease. For the Corporations, Mr. R. H. Adcock, Deputy Town Clerk of Manchester, quoted from train time-tables to show that the train service between Manchester and Gatley was roughly hourly, while there was a quarter-hour service of omnibuses.

SMALL MARINE MOTORS AT THE BUENOS AIRES EXHIBITION

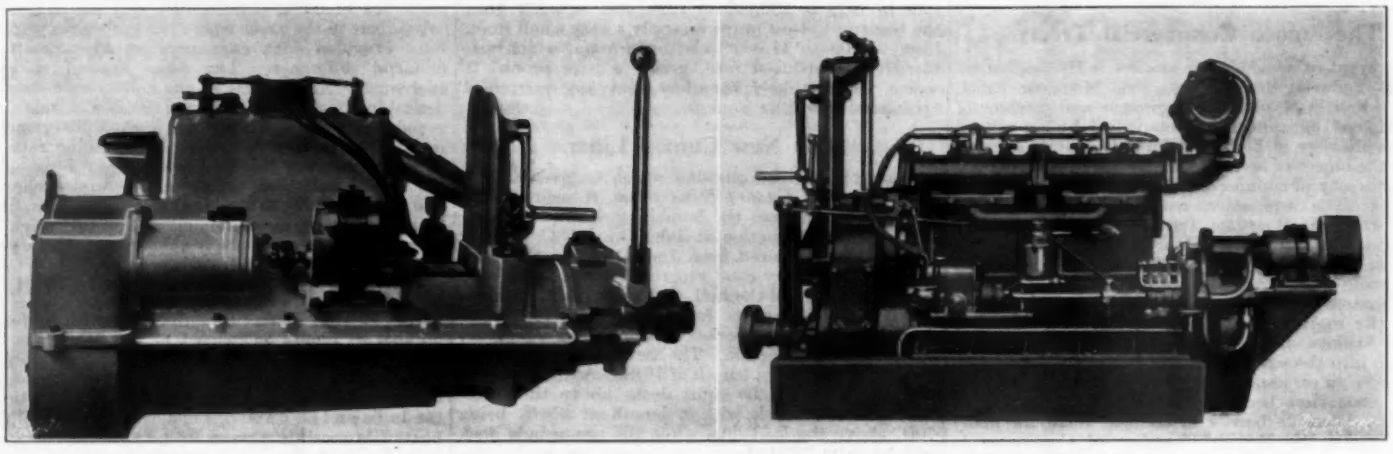


FIG. 65—10 B.H.P. FOUR-CYLINDER ENGINE—BROOKE

FIG. 66—30-36 B.H.P. FOUR-CYLINDER ENGINE—ATLANTIC

Buenos Aires Trade Exhibition.

No. VII. (*Conclusion*).*

THE present article concludes the series devoted to the Buenos Aires Exhibition. In order to make it possible to publish the articles week by week, simultaneously in South America and Great Britain, they had to be written before the Exhibition opened, and even now we are not in a position to say anything about the success—which we feel is assured—of this demonstration of the capability of the Empire to supply the needs of the South American republics. We hope, however, to print at an early date a general review, written by our representative in Buenos Aires, of the result obtained. On one or two previous occasions we have found it necessary to speak firmly about the lack of response which manufacturers have shown to our invitation to deal with their exhibits. We are happy to say that in this instance they have displayed every disposition to take advantage of our offer, and have supplied us with the necessary illustrations and text without delay.

Este artículo cierra la série dedicada a la Exposición de Buenos Aires. Para que fuera posible publicar los artículos cada semana, simultáneamente en Sud América y en la Gran Bretaña, tuvieron que ser escritos antes de la apertura de la Exposición y aún hoy, no estamos en condiciones de decir algo respecto al éxito-el que creemos es seguro de esta demostración de la capacidad del Imperio de llenar las exijencias y necesidades de las repúblicas sudamericanas. Esperamos, sin embargo, publicar pronto una descripción general o revista escrita por nuestro representante en Buenos Aires, del resultado obtenido. Hemos tenido necesidad, en una o dos ocasiones previas, de hablar seriamente de la falta de voluntad que algunos manufactureros mostraron cuando los invitamos a ocuparse de sus renglones expuestos. Nos es agradable decir que en este caso, ellos han demostrado grandes deseos de aprovechar nuestra oferta y nos han suministrado los grabados y textos necesarios sin demora alguna.

SMALL MARINE MOTORS.

The makers of British marine oil engines, of the petrol, paraffin, and heavy-oil types, have sent out a representative display of their products.

A noteworthy engine of the heavy-oil type is that shown by the Ailsa Craig Motor Company, Ltd., of Chiswick, London, a section of which is reproduced in Fig. 67. It operates on the Acro principle, which was fully described in our issue of June 10th, 1927, and is referred to in our article on the A.E.C.-Acro engine—see THE ENGINEER for April 3rd, 1931. The main feature is the special form of combustion chamber, which is connected to the cylinder space by a restricted Venturi passage. The fuel from the atomiser is directed into this passage, the fuel valve closing about 15 deg. after the dead centre. A portion of the fuel charge becomes automatically ignited, and the ensuing rise of pressure in the chamber forces the fuel and air into the combustion space at a high velocity, ensuring regular combustion. Our engraving indicates the relative positions of the atomiser, fuel pumps, and governor, and the starter and dynamo. With a bore of 4½in. and a stroke of 6½in. an output of 40 to 60 B.H.P. is obtained on four cylinders, the engine running at 900 to 1400 r.p.m.

* No. VI. appeared April 17th.

The petrol engines exhibited by the firm are the new 12 to 20 and 20 to 35 horse-power, four-cylinder marine motors.

The firm of J. W. Brooke and Co., Ltd., of Lowestoft, is showing a range of three petrol engines, specially designed for launches, cruisers, and workboats. The largest engine is a six-cylinder, 105 B.H.P., 2000 r.p.m. unit, with a bore of 4¼in. and a stroke of 4¾in., with a dry sump and forced lubrication to all running parts. The reversing gear has a positive neutral point and gives full propeller speed astern. A self-contained electric starting and lighting set forms part of the equipment. The 15 to 40 B.H.P. six-cylinder engine embodies some of the features above mentioned, an additional advantage being the use of duplex chain drives for the

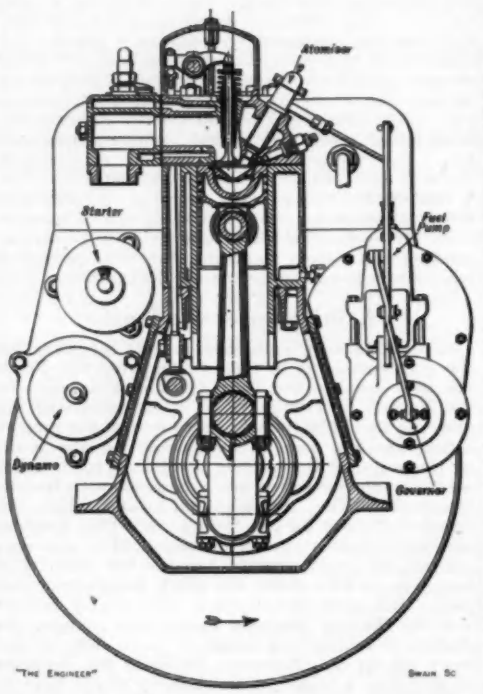


FIG. 67—SECTION THROUGH ENGINE—AILSA-CRAIG

overhead valve gear which reduces noise. The engine is designed to run at 3000 r.p.m., and has a cylinder bore of 2⅝in. with a stroke of 4in. The smallest unit is the firm's "Empire" four-cylinder 10 horse-power engine at 1000 r.p.m., with an enclosed fly-wheel and a single control reversing gear. This engine, which is illustrated in Fig. 65, also has a bore of 2⅝in., with a 4in. stroke.

A very complete exhibit of marine motors, propellers and stern gear, and a range of models, is shown by John I. Thornycroft and Co., Ltd., of Thornycroft House, Smith-square, London. In Fig. 69 we illustrate one of the latest Thornycroft engines, the six-cylinder, which is designed to develop 55 B.H.P. on paraffin and 75 B.H.P. on petrol. It is equipped with a reducing gear of 4 to 1 ratio, but a 2½ to 1 ratio gear can also be supplied. Prior to being put into actual production at the firm's Reading works, this particular engine underwent a successful 300 hours' non-stop run under the supervision of Lloyds' Register of Shipping, when it developed an average power higher than its rated output. Amongst the larger engines on view are a 140 B.H.P. six-cylinder engine for hydroplanes and high-speed cruisers, and one of the well-known 400 B.H.P. "Y" type, twelve-cylinder coastal motor boat engines. Among the smaller engines, we may briefly refer to the 9 B.H.P. "Handybilly," the smallest made by the firm, and the standard four-cylinder 30 and 35 B.H.P. types, which are available for either paraffin or petrol fuel, and can be equipped with speed reducing gear.

The exhibit of the Atlantic Engine Company, Ltd., of Wishaw, Scotland, comprises two units. The first is a six-cylinder model of the four-cylinder type with reversing gear, which has been designed for British Admiralty and foreign navy requirements. It has a designed output of 45 to 48 B.H.P. on paraffin and 51 to 54 B.H.P. on petrol at 850 to 900 r.p.m., and the cylinder bore is 5in. with a stroke of 6in. The vaporisers are specially designed to use low-grade paraffin as supplied on the South American coast. The second engine, a view of which we reproduce in Fig. 66, has an output of 26 to 30 B.H.P. on paraffin and 32 to 36 B.H.P. on petrol, and runs at 1000 r.p.m., the four cylinders having a bore of 4½in., with a stroke of 5½in. The firm has supplied several of these engines for the motor lifeboats of large British passenger liners, while some of the larger sizes of engines have been built for emergency lighting sets for marine service.

Two four-cylinder engines of the type illustrated in Fig. 70 are shown by W. H. Dorman and Co., Ltd., of Stafford and London. The smaller has a designed output of 20 to 30 horse-power at 1000 to 1600 r.p.m. on petrol and 14 horse-power at 1000 r.p.m. on paraffin, while the larger gives 22 to

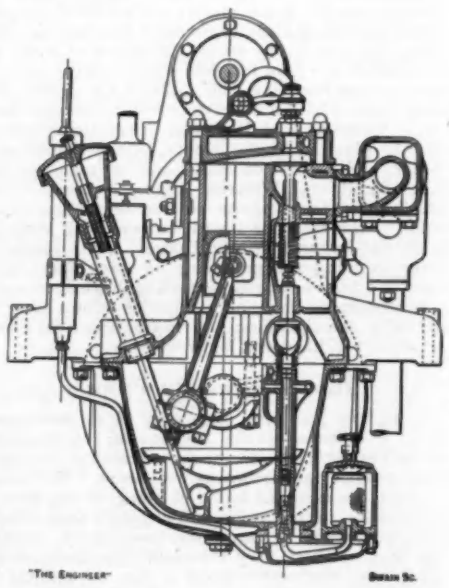


FIG. 68—SECTION THROUGH ENGINE—MORRIS

40 horse-power on petrol at 1000 to 1800 r.p.m., and 15 horse-power on paraffin at 1000 r.p.m., the cylinder bore of the smaller engine being 80 mm., and that of the larger engine 85 mm., the stroke in both cases being 130 mm. A full description of these engines will be found in THE ENGINEER for November 7th last.

In Fig. 68 we reproduce a section through a Morris marine engine made by Morris Motors, Ltd. (Marine Department), of Cowley, Oxford. Two engines are exhibited, one being the 12-24 "Navigator" four-cylinder engine and the other the 18-50 "Commodore" six-cylinder engine, both of them being complete with a self-contained reverse gear and starting equipment. The smaller engine has a 75 mm. bore and 102 mm. stroke, with a speed range

of 300 to 2000 r.p.m., while the bore and stroke of the larger unit are 69 mm. and 110 mm. respectively, and the speed range 300 to 3000 r.p.m. Besides the engines we have mentioned the firm supplies larger sizes with designed outputs up to 56 B.H.P.

Los fabricantes de motores marinos a petróleo británicos, de los tipos de nafta, kerosene, y aceites pesados, han enviado un despliegue que representa bién sus productos.

Un motor digno de nota del tipo de aceite pesado es el expuesto por la Ailsa Craig Motor Company, Ltd., de Chiswick, en Londres, del cual reproducimos una sección en la figura 67. Trabaja de acuerdo con el principio de Acro, que describimos plenamente en nuestra edición del 10 de junio de 1927, y que mencionamos en nuestro artículo que trata del motor Acro-A.E.C.—véase el número de abril 3 de 1931. El rasgo principal es la forma especial de la cámara de combustión, que va unida al espacio de cilindro por un pasaje Venturi muy limitado. El petróleo del pulverizador se dirige a ese pasage, cerrándose la válvula de petróleo a unos 15 grados después del punto muerto. Una porción del combustible de la carga se enciende automáticamente, y la consiguiente subida de presión en la cámara fuerza al aire y al petróleo a entrar en el espacio de combustión a una gran velocidad, asegurando así una combustión regular. Nuestra figura indica las posiciones relativas del pulverizador, bombas para el combustible, y regulador, y el arrancador y dinamo. Con un alma o diámetro de 4½″ (114,3 mm.) y una carrera de 6½″ (165,1 mm.) se obtiene una potencia de 40 a 60 caballos ingleses de fuerza con cuatro cilindros, a una velocidad de 900 a 1400 revoluciones por minuto. Los motores a nafta expuestos por la firma son los muevos de 12 a 20 y 20 a 35 caballos, de cuatro cilindros para marina.

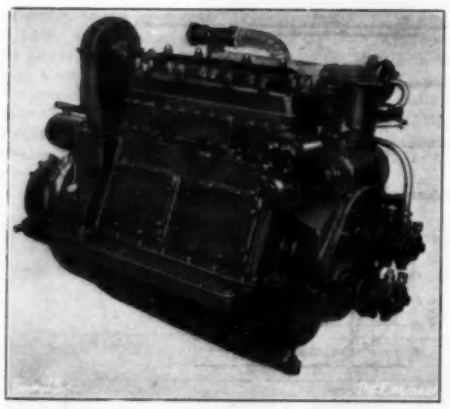


FIG. 70—FOUR-CYLINDER ENGINE—DORMAN

La firma de J. W. Brooke & Co., Ltd., de Lowestoft, muestra una variedad de tres motores de nafta, proyectados especialmente para lanchas, cruceros, y embarcaciones de trabajo. El motor mas grande es uno de seis cilindros de 105 caballos a 2000 revoluciones por minuto, con un alma de 4½″ (114,3 mm.) y una carrera de 4¾″ (120,65 mm.) con sentina seca para aceite y enaceitado bajo presión para todas las partes móviles. El mecanismo de la contramarcha tiene un punto neutral positivo y da toda marcha hacia atrás en la hélice. Un juego compacto para el arranque y alumbrado eléctricos forma parte del conjunto. El motor de seis cilindros de 15 a 40 caballos comprende algunos de los rasgos ya mencionados, siendo el uso de cadenas gemelas una ventaja adicional para el mecanismo de levas de las válvulas en la culata, que reduce el ruido. El motor ha sido proyectado para girar a 3000 r.p.m. y tiene un alma de cilindro de 2⅝″ (66,7 mm.) con una carrera de 4″ (101,6 mm.). La unidad mas pequeña es el motor de la firma "Empire" de 4 cilindros, 10 caballos a 1000 revoluciones por minuto, con un volante encerrado y una contra-marcha de una palanca. Este motor, que se ve en la figura 65, tiene también un diámetro de cilindro de 66,7 mm. con una carrera de 101,6 mm. Un despliegue muy completo de motores marinos, hélices y material para gobierno, y un surtido de modelos, es el expuesto por John Thornycroft & Co., Ltd., de Thornycroft House, Smith-square, en Londres. En la figura 69 mostramos uno de los últimos motores de Thornycroft, el seis cilindros, que ha sido proyectado para desarrollar 55 caballos ingleses con kerosene y 75 con nafta. Va equipado con una reducción de 4 a 1, pero también se proporciona una reducción de 2½ a 1. Antes de que se empezara la fabricación de este motor en los talleres de la firma en Reading, este tipo especialmente, pasó por una prueba de 300 horas sin parar vigilado por el Lloyd's Register of Shipping, en la que desarrolló una potencia media mayor que su rendimiento calculado. Entre los otros motores grandes a la vista está un seis cilindros de 140 caballos ingleses de fuerza para hidroplanos y cruceros de gran velocidad, y uno de los muy conocidos motores marinos para embarcaciones costeras de doce cilindros 400 caballos, tipo "Y." Entre los motores mas pequeños podemos referirnos brevemente al de 9 H.P. "Hanydbilly," el mas chico de los hechos por la casa, y el normal de cuatro cilindros de los tipos de 30 y 35 caballos, que se pueden usar con nafta o con kerosene, y pueden suministrarse con caja de reducción de velocidad.

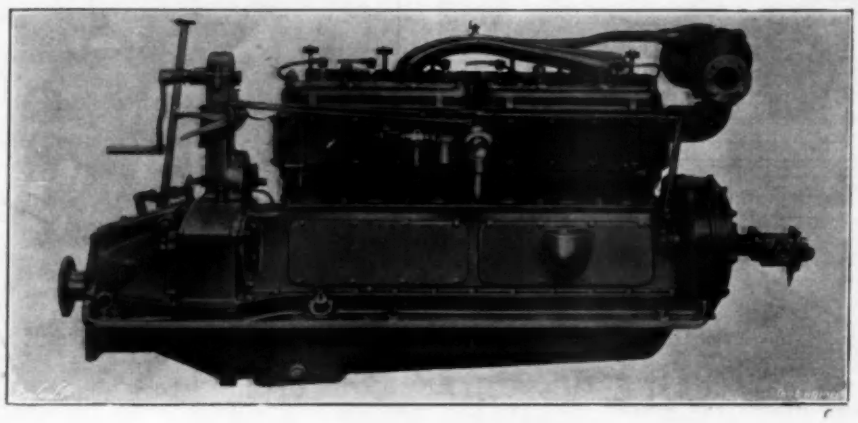


FIG. 69—55 B.H.P. SIX-CYLINDER MARINE ENGINE—THORNYCROFT

Lo expuesto por la Atlantic Engine Company, Ltd., de Wishaw, en Escocia, comprende dos unidades. La primera es un motor de 6 cilindros del tipo de 4 cilindros con contramarcha, que ha sido proyectado para llenar las condiciones del Almirantazgo Británico y marinas extranjeras. Tiene un rinde calculado de 45 a 48 caballos de fuerza quemando kerosene, y 51 a 54 HP. quemando nafta, a 850–900 revoluciones por minuto, y el alma del cilindro es de 5″ (127 mm.) con una carera de 6″ (152,4 mm.). Los vaporizadores están hechos especialmente para que puedan usar el kerosene de baja calidad que se vende en las costas de Sud América. El segundo motor, del cual damos una vista en la figura 66, tiene un rinde de 26 a 30 caballos con kerosene, y uno de 32 a 36 con nafta, y gira a 1000 r.p.m., los cuatro cilindros tienen un diámetro de 4¼″ (107,9 mm.) con una carrera de 5½″ (139,7). La firma ha suministrado varias de estas máquinas para los botes salvavidas a motor de los grandes transatlánticos británicos para pasajeros, mientras que algunos de los tamaños mas grandes han sido construidos para instalaciones para alumbrado de emergencia para servicio de la marina. Dos motores de 4 cilindros del tipo representado en la figura 70 se ven expuestos por W. H. Dorman and Co., Ltd., de Stafford y Londres. El mas chico tiene un rendimiento calculado de 20 a 30 caballos a 1000 o 1600 revoluciones por minuto a nafta, y 14 HP. a 1000 r.p.m. a kerosene, en tanto que el mayor da 22 a 40 caballos con nafta y a 1000 o 1600 r.p.m., y 15 caballos con kerosene a 1000 r.p.m., siendo el alma del cilindro del motor pequeño 80 mm., y el alma del mayor 85 mm., la carrera en ambos casos es de 130 mm. Se hallará una descripción detallada de estos motores en THE ENGINEER del 7 de noviembre ppdo.

En la figura 68 reproducimos una sección del motor marino de Morris fabricado por Morris Motors, Ltd. (Departamente de Marina), de Cowley, en Oxford. Se expone dos motores, uno es el "Navigator" de 4 cilindros de 12–24 caballos, y el otro es el "Comodore" de seis cilindros, ambos completos con contramarcha compacta y aparato de puesta en marcha. El motor mas pequeño tiene un alma o diámetro de cilindro de 75 mm. y 102 de carrera, con una variación de velocidad de 300 a 2000 revoluciones por minuto, entanto que el alma y la carrera del motor mas grande son de 69 mm. y 110 mm. respectivamente, y la variación de velocidad de 300 a 3000 r.p.m. A más de los motores a que nos hemos referido, la firma suministra tamaños mas grandes con rendimientos calculados hasta 56 caballos ingleses de fuerza.

PNEUMATIC ENGINEERING.

Broom and Wade, Ltd., of High Wycombe, have a number of interesting machines among its exhibits. A 100 cubic foot portable petrol engine-driven compressor plant embodies the firm's latest patented sleeve valve compressor, which, the makers claim, ensures high efficiency at comparatively high speeds, making the compressor very suitable for portable units. A vertical totally enclosed compressor with pressure-feed lubrication to all bearings has a capacity of 25 cubic feet per minute and is made in a large range of sizes. Thirty-four machines of this type were supplied in connection with the Buenos Aires municipal sewage scheme. Fig. 71 illustrates a "Broomwade" rotary type compressor or exhauster. These machines are made in a range of sizes ranging from 6 to 2000 cubic feet displacement. Various pneumatic tools are also shown.

The Consolidated Pneumatic Tool Company, Ltd., of Piccadilly, London, is showing a range of pneumatic tools of all sorts in action, the compressed air being supplied by a portable petrol-driven air compressor plant built up by the firm.

The Howard Pneumatic Engineering Company, Ltd., is showing a range of its tools, including hammers, drills, picks, &c., and also its "John Bull" portable petrol engine-driven drill, further details of which will be found in the issue of this paper of December 16th, 1927.

Los Sres. Broom & Wade, Ltd., de High Wycombe, tienen un número vasto de máquinas interesantes entre las cosas que exponen. Una instalación para 100 piés cúbicos (2,83 m.³) portátil accionada por un motor de nafta comprende el último modelo de compresor patentado de válvula de corredera o deslizante. Los fabricantes pretenden que esta permite gran eficiencia a grandes velocidades relativamente, y que el compresor es por esto muy conveniente para grupos portátiles. Un compresor herméticamente cerrado, vertical, con lubrificación forzada por presión en todos los cojinetes, tiene una capacidad de 25 piés cúbicos por minuto (0,708 m.³), y se fabrica en gran variedad de tamaños. Treinta y cuatro de estas máquinas fueron suministradas con motivo del proyecto de cloacas municipales de Buenos Aires. La figura 71 muestra un compresor o exhaustor rotativo "Broomwade." Estas máquinas están hechas en una variedad de tamaños que va desde 6 a 2000 piés cúbicos de desplazamiento (0,17 a 57 m.³). Se expone también varias herramientas neumáticas. The Consolidated Pneumatic Tool Company, Ltd., de Piccadilly, en Londres, muestra un surtido de útiles neumáticos de todas clases en acción, para los cuales se surte el aire comprimido por medio de un compresor de aire movido por motor de petróleo fabricado por la firma. The Howard Pneumatic Engineering Company, Ltd., expone un surtido de sus herramientas, incluyendo martillos, perforadoras, picos, etc., y también su "John Bull" que es una perforadora portátil movida por motor de petróleo, de la cual dimos una descripción en nuestro número del 16 de diciembre de 1927.

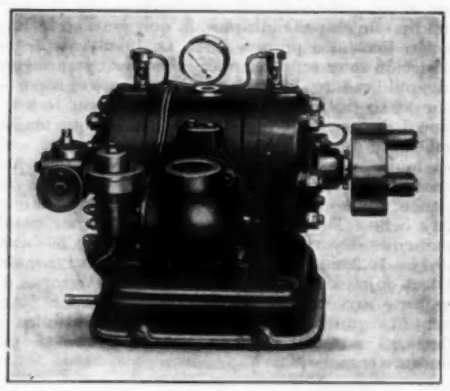


FIG. 71—ROTARY TYPE COMPRESSOR—BROOM AND WADE

HOLDEN AND BROOKE, LTD.

One of the most interesting machines exhibited by Holden and Brooke, Ltd., of Manchester, is the "Selfix" hot water circulator. In this device for accelerating the flow of the water a non-return valve is fitted in the main pipe line and a motor-driven centrifugal pump is mounted above it. The pump sucks from one side of the non-return valve and delivers to the other through isolating valves, the direction of flow being that in which the water would normally flow to open the valve. The unit is very compact, and the makers claim many advantages for the arrangement.

Fig. 72 illustrates a new design of centrifugal pump recently brought out by the firm. It is of

the multi-stage type, that being shown at the Exhibition having two impellers. The pump is very simply constructed, neither guide rings nor hydraulic balancing being included and the thrust being taken by the main bearings, which are of the ball type. It is so made that from a sufficient stock of parts any pump from one to four stages can be built up, and it will be seen that the parts are held together by "through" bolts, of which there are eight. In this way pumps can be constructed to deliver against heads of 30ft. to 250ft., while running at reasonable speeds.

Other exhibits by the same firm are steam traps and injectors. The "Autovent" steam trap, so the makers claim, is the only one which automatically discharges any air which collects during working.

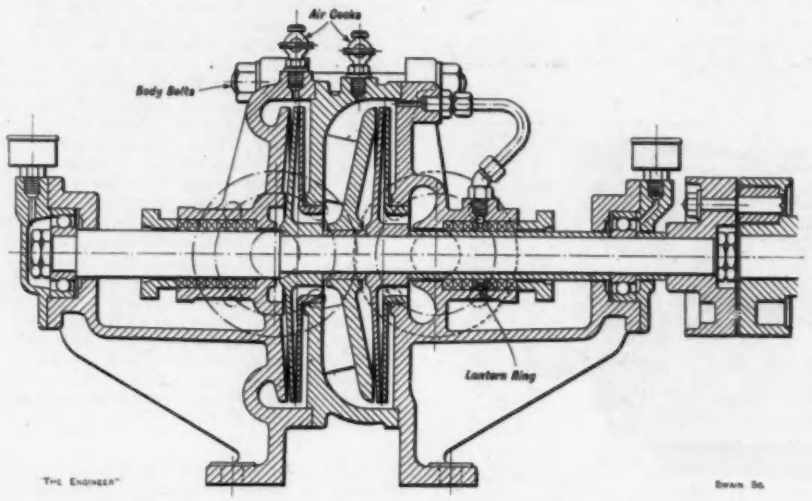


FIG. 72—MULTI-STAGE CENTRIFUGAL PUMP—HOLDEN AND BROOKE

Una de las máquinas mas interesantes expuestas por Holden & Brooke, Ltda., de Manchester, es la "Selfix," un circulador de agua caliente. En este aparato para acelerar la circulación de agua, se pone una válvula de retén en la cañería principal y se coloca una bomba centrífuga movida por motor encima de la misma. La bomba aspira por un lado de la válvula de retén y descarga en el otro lado por medio de otras válvulas de separación aisladoras, siendo la dirección del flujo aquella en que el agua correría para abrir la válvula. El conjunto es muy compacto, y los fabricantes declaran que el arreglo tiene muchas ventajas.

La figura 72 muestra un nuevo diseño de bomba centrífuga producido recientemente por la firma. Es del tipo de etapas múltiples, la que se ve en la Exposición tiene dos propulsores. La bomba es de construcción muy sencilla, pués no se incluye aros guías ni equilibradores hidráulicos y el empuje es soportado por los cojinetes principales, los que son todos del tipo de bolas. Está hecha de tal manera que teniendo suficiente número de piezas a mano, se podrá armar cualquier tipo de estas bombas desde una hasta cuatro etapas, y se observará que las partes se mantienen unidas por pernos "pasadores," de los cuales hay ocho. De este modo es posible armar bombas para que descarguen contra presiones de 30′ a 250′ (9,14 a 76,2 metros), girando a velocidades razonables. Otros objetos expuestos de la firma son trampas para vapor e inyectores. La trampa para vapor "Autovent," según dicen los fabricantes, es la única que descarga automáticamente todo aire que se junte durante el trabajo.

British Oxygen Company, Ltd.

Oxygen-cutting machines are the chief exhibits of the British Oxygen Company, Ltd., and the drawing, Fig. 73, shows the 55in. size. This machine was introduced about six years ago, but has been considerably improved. A multi-speed gear-box provides cutting speeds suitable for any work which the machine is capable of handling. It is mounted on the column, the drive being taken to the profile tracing roller through shafts and gearing. The templet holder is universally adjustable and can, in consequence, be set rapidly over a marked-out job, so that there is no necessity to shift the material once it has been placed on the work table. The height of the cutter may be altered while the machine is in operation without interfering with the shape cut, and no attention whatever is required once the cut has started, as the cutting speed is constant whatever the shape of the templet. Although the work table is entirely closed the ashpan is accessible for cleaning purposes by removal of the sides. All gearing is enclosed and all shafts run in ball bearings. The machine will deal with material from ⅛in. to 15in. in thickness, will make a straight cut 10ft. in length, and cut a circle 4ft. 8in. in diameter. It occupies a floor space 7ft. 6in. by 5ft., and has a height of 8ft. 2in.

Las máquinas de cortar con soplete oxídrico son el renglón mas importante de lo expuesto por la British Oxigen Company, Ltda., y el dibujo, figura 73, muestra el modelo de 55″ (1397 mm.). Esta máquina fué puesta en el mercado hace cerca de seis años, pero ha sido mejorada enormemente. Una caja de muchas velocidades proporciona velocidades de corte convenientes para cualquier trabajo que la máquina pueda ejecutar. Va montado en la columna, y el movimiento se transmite al rodillo del contorneador por medio de ejes y engranages. El porta plantilla puede ajustarse en cualquier posición y puede, por eso, fijarse rápidamente en cualquier trabajo delineado, de manera que no haya necesidad de mover el material una vez que esté sobre la mesa de trabajo. La altura del cortador puede ser alterada durante la operación, sin que se modifique la forma del corte, y no se requiere atención alguna una vez que el corte ha empezado, pués la velocidad de corte es constante cualquiera que sea la forma de la plantilla. Aunque la mesa de trabajo es enteramente cerrada, el cenicero es de fácil acceso para limpiarlo sacando las tapas laterales. Todos los engranages están encerrados y todos los ejes se mueven en cojinetes de bolas. La máquina cortará material desde ½″ (3,2 mm.) hasta 15″ (381 mm.) de espesor, puede cortar un corte recto de 10′ (3,05 metros) de largo, y cortar un círculo de 4′ 8″ de diámetro (1423 mm.). Ocupa un espacio de piso de 7′ 6″ por 5′ (2286 mm. por 1524 mm.) y tiene una altura de 8′ 2″ (2489 mm.).

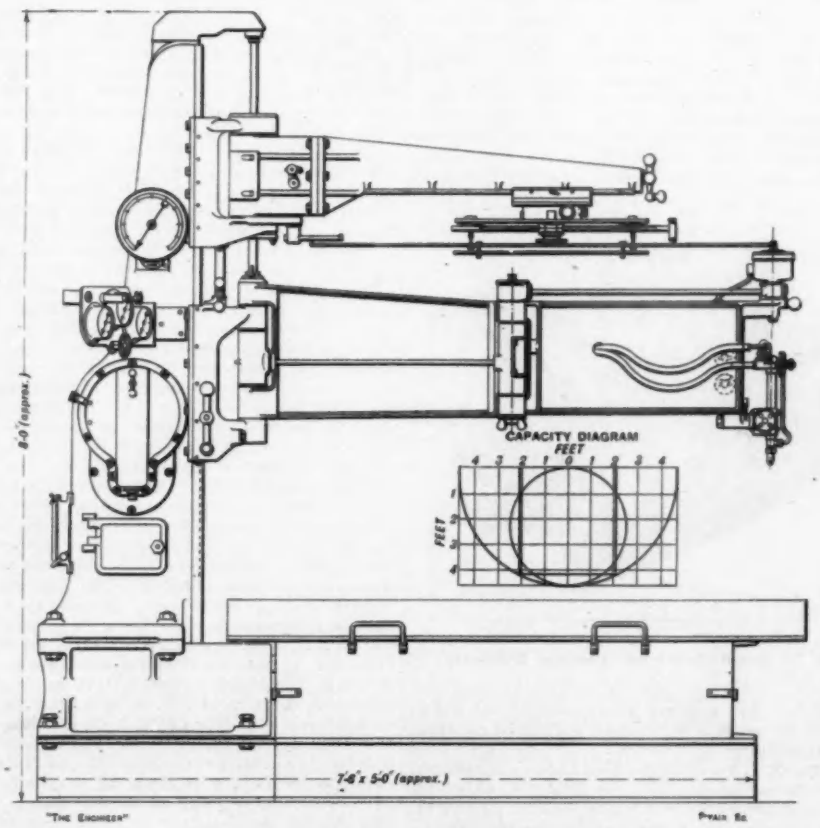


FIG. 73—55IN. OXYGEN CUTTING MACHINE—BRITISH OXYGEN

Marshall, Sons and Co., Ltd.
Clayton and Shuttleworth, Ltd.

A combined exhibit is arranged by Marshall, Sons and Co., Ltd., of Gainsborough, and Clayton and Shuttleworth, Ltd., of Lincoln. The exhibits of the former firm include the latest type of Marshall concrete mixer, which we show in Fig. 74. It is of the tilting-drum type, and is driven by a Lister petrol engine. The machine is transportable, being carried on a specially designed chassis with the tilting mechanism operated by conveniently placed controls. The firm supplies six different models, with outputs of 4 to 10 cubic feet per batch, and for larger outputs four sizes of rotary drum machines, with outputs of 13½, 21, 27, and 42 cubic feet per batch.

FIG. 74—CONCRETE MIXER—MARSHALL

The "Manumit" motor roller made by the same firm is also being shown. A description of this will be found in a Supplement to our issue for February 14th, 1930.

In Fig. 75 we illustrate a maize sheller made by Clayton and Shuttleworth, Ltd., of Lincoln. This, as will be seen from the illustration, is well designed and robust. It has an all-steel frame, and its size is 3ft. 6in.

An oil engine tractor on the same stand is rated at 15–30 H.P. It is of the agricultural type, and the makers claim that it has a considerably lower

fuel cost per acre ploughed than petrol or paraffin tractors.

Un despliegue combinado es el de los Sres. Marshall, Sons & Co., Ltda., de Gainsborough, y Clayton y Shuttleworth, Ltda., de Lincoln. Los objetos expuestos por la primera firma incluyen el último modelo de mezclador de concreto de Marshall, el que se ve en la figura 74. Es del tipo de tambor oscilante, y está movido por un motor a nafta Lister. La máquina es transportable, soportada por un chassis

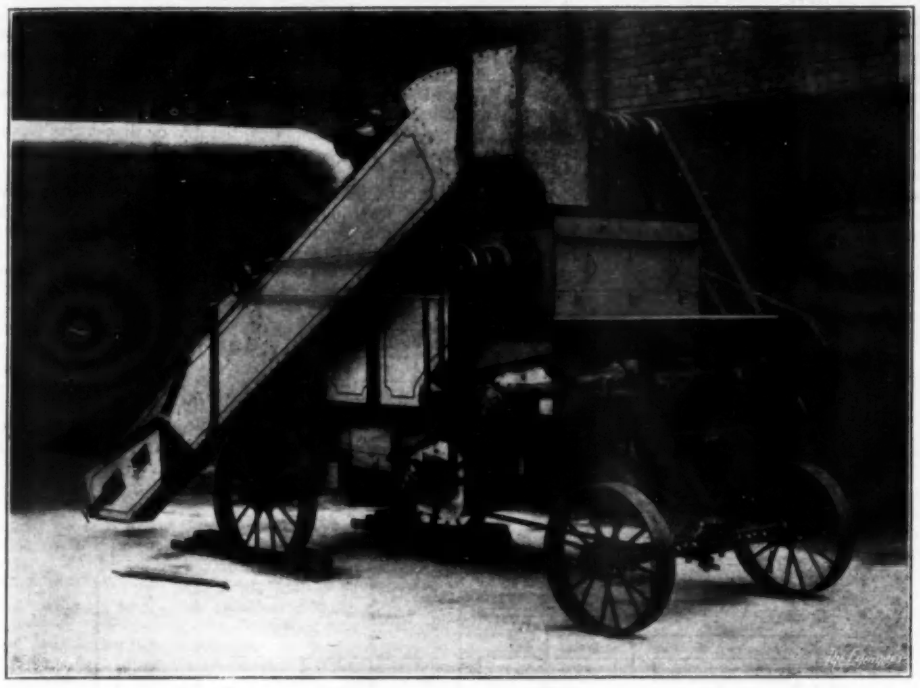


FIG. 75—ALL-STEEL FRAME MAIZE-SHELLER—CLAYTON

proyectado especialmente para poder actuar sobre el mecanismo de volcar desde controles de fácil acceso. La firma entrega seis modelos diferentes, con rendimientos desde 4 hasta 10 piés cúbicos por vez (0,113 a 0,283 m.³), y para rendimientos mayores cuatro tamaños de máquinas de tambores rotatorios, con rindes de 13½, 21, 27, y 42 piés cúbicos por vez (0,372, 0,594, 0,764, 1,189 m.³). La "Manumit" es una aplanadora a motor hecha por la misma firma y también expuesta por ella. Se hallará una descripción de esta máquina en un Suplemento de nuestra edición de febrero 14 de 1930.

En la figura 75 se verá una peladora de maíz fabricada por Clayton y Shuttleworth, Ltda., de Lincoln. Esta como se desprende de la figura, está bién proyectada y es robusta. Tiene un armazón de acero, y su tamaño es de 3′ 6″ (1,066 metros).

Un tractor con motor de petróleo en el mismo stand está calculado para 15–30 caballos. Es del tipo agrícola, y los fabricantes aseguran que tiene un gasto considerablemente menor por hectárea arada que los tractores movidos por nafta o por kerosene.

BEYER, PEACOCK AND CO., LTD.

In the locomotive section of the Exhibition, railway engineers will find much to interest them in the exhibits of Beyer-Peacock and Co., Ltd., of

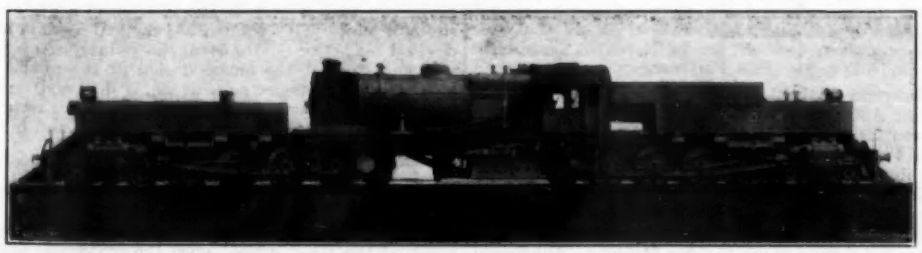


FIG. 76—BEYER-GARRATT ARTICULATED LOCOMOTIVE

Manchester. One of the "Beyer-Garratt" articulated locomotives, similar to those which are already in service on the Buenos Aires and Pacific Railway —5ft. 6in. gauge—is exhibited. In Fig. 76, we reproduce a photograph of an engine of this type. It develops a tractive effort of 50,240 lb. at 85 per cent. boiler pressure, and the boiler has a total heating surface of 2958 square feet. In working order it weighs 194 tons, of which 113 tons are available for adhesion. Another exhibit is a working scale model of one of six "Beyer-Garratt" locomotives supplied to the Benguela Railway in 1927. A new form of self-trimming coal bunker, which has recently been patented by the company, and which is claimed to give very good results under service conditions, is demonstrated by another model. The world-wide activities of the firm are shown by a number of photographs.

En la sección de locomotoras de la Exposición encontrarán los ingenieros ferrocarrileros mucho de interés para ellos en lo expuesto por Beyer, Peacock & Cía., Ltda., de Manchester. Una de las locomotoras articuladas de "Beyer-Garratt," parecida a las que están actualmente en servicio en el F. C. de Buenos Aires al Pacífico—de 5′ 6″ (1·67 m.) de trocha—está a la vista. En la figura 76 reproducimos una fotografía de una máquina de este tipo. Desarrolla un esfuerzo tractor de 50,240 libras (22,660 kg.) a una presión de caldera equivalente al 85% solamente, y la caldera tiene una superficie de calefacción de 2958 piés cuadrados (274,7 m.²). Pesa en órden de marcha 194 toneladas, de las cuales 113 toneladas se utilizan para adhesión. Otro renglón expuesto es un modelo activo en pequeña escala de una de las seis locomotoras "Beyer-Garratt" entregadas al F.C. de Benguela en 1927. Otro modelo muestra una forma nueva de carbonera con emparejador automático que ha sido patentado recientemente por la compañía, y que se dice da muy buenos resultados en condiciones de servicio muy severas. Las actividades mundiales de ésta firma van explicadas por un número de fotografías.

OTHER MAKERS.

A number of other makers are also exhibiting interesting machines, devices, appliances, or materials. British Insulated Cables, Ltd., of Prescot, are showing a range of cables, a butt welder, and various types of insulated wires. Murex Welding Processes, Ltd., of Walthamstow, London, have made arrangements to demonstrate electric arc welding and the "Premag" process of welding copper. Softening plants, both household and industrial, are shown by Bell Brothers, Ltd., of Manchester; these well repay examination. British Separators, Ltd., of York, are showing their "Vickcen" separators. One of the machines, the makers state, has been specially designed for service in South America. Steel makers and ironfounders are represented by Brown, Bayley's Steel Works, Ltd., of Sheffield, which is showing various steel products, and Samuel Pegg and Son, of Leicester, who are showing a "Pegson" power tamper and a "Pegson" live-wire screen. Dorman, Long and Co., Ltd., are showing a number of their by-products, such as tar, creosote, &c., grades of pig iron and photographs of structural steel work, and the Steel Nut and Joseph Hampton, Ltd., are showing bolts and nuts, tools and malleable and grey iron castings. Bertrams, Ltd., of Edinburgh, exhibit a "Universal" punching, shearing, bar angle and tee-bevel cropping machine. Diving apparatus of all kinds and aviation instruments, and various safety and protective devices are shown by Siebe, Gorman and Co., Ltd., of Westminster Bridge-road, London; Oldham and Son, Ltd., of Denton, have their batteries and lamps on view, and the Aerogen Company, Ltd., exhibits gas generators. Heating, ventilating and air conditioning plant for industrial, commercial or public buildings, vacuum cleaning plant, and many other machines, can be seen among the exhibits by the Sturtevant Engineering Company, Ltd., of Queen Victoria-street, London. The Menno Compressed Air Grease Cup Company, Ltd., of Tollington Park, London, is showing grease cups and lubricators. The exhibits of Imperial Chemical Industries, Ltd., of Millbank, London, are arranged to show how its varied products serve the needs of local industries. Chance Brothers and Co., Ltd., of Birmingham, are showing searchlights and floodlights, and Alexander Shanks and Son, Ltd., of Westminster, are displaying a selection of lawn mowers; Fleming, Birkby and Goodall, of Halifax, have arranged an exhibit to show three "Teon" belts, working in an atmosphere full of steam, heated by a gas jet at one point, and with a stream of water flowing over it respectively, and Watson, Laidlaw and Co., Ltd., of Glasgow, exhibit hydro-extractors. "Mopump" centrifugal pumps and motors are shown by Rhodes, Brydon and Youatt, Ltd., of Stockport, and the Mercury Truck and Tractor Company, of Victoria-street, London, is showing photographs of its tractors and trucks. The Chesterfield Tube Company, Ltd., of Chesterfield, displays cold-drawn weldless steel steam pipes, "Peroma" tubes and various steel cylinders, and Wingate's Ltd., Grosvenor-gardens, London, is showing concrete mixers, &c. Clocks for workmen and others throughout the Exhibition were provided by Gent and Co., Ltd., of Leicester. E. Green and Son, Ltd., of Wakefield, are showing economisers and air heaters, and the Staveley Coal and Iron Company, Ltd., of Chesterfield, cast iron pipes, pig iron and coal and chemicals.

Numerosos fabricantes exponen también máquinas interesantes, artefactos, artificios, o materiales. La British Insulated Cables, Ltd., de Prescot, expone un surtido de cables, un soldador de tope, y varios tipos de alambres aislados. La Murex Welding Process, Ltd., de Walthamstow en Londres, ha hecho arreglos para demostrar como se suelda con arco eléctrico y el método "Premag" de soldar cobre. Purificadores de agua, tanto para industrias como domésticos, están a la vista, hecho por Bell Brothers, Ltd., de Manchester; sin duda conviene examinarlos. La British Separators, Ltd., de York, exponen sus separadores "Vickcen." Según los fabricantes, una de las máquinas ha sido fabricada para trabajar en Sud América. Los fabricantes de acero y fundidores están representados por Brown, Bayley's Steel Works, Ltd., de Sheffield, quienes exponen varios productos de acero, y Samuel Pegg & Son, de Leicester, que exponen un pisón mecánico "Pegson" y una criba "Pegson" de hilo activo. Los señores Dorman, Long & Co., Ltd., exponen una variedad de sus productos secundarios, como ser alquitrán, creosota, etc., clases de hierro colado y fotografías de estructuras metálicas de acero, y la Steel Nut & Joseph Hampton, Ltd., exponen pernos bulones y tuercas, herramientas y piezas de hierro gris y maleable. La firma Bertrams, Ltd., de Edinburgo, expone una máquina para perforar, cizallar, y cortar ángulos y tees. Los señores Siebe, Gorman & Co., Ltd., de Westminster Bridge-road, de Londres, exponen aparatos para buzos, de todas clases, y aparatos para aviación, asi como varios artefactos para seguridad y protección. La firma Oldham & Son, Ltd., de Denton, tienen sus baterías y lámparas a la vista, y la Aerogen Company, Ltd., expone generadores de gas. Las instalaciones para calefacción, ventilación y purificación de aire para edificios industriales, comerciales o públicos, instalaciones para limpieza al vacío, y muchas otras máquinas, se verán entre los artículos expuestos por la Sturtevant Engineering Company, Ltd., de Queen Victoria-street, en Londres. The Menno Compressed Air Grease Company, Ltd., de Tollington Park, en Londres, expone engrasadores y aceiteras. Los renglones de la Imperial Chemical Industries, Ltd., de Millbank, en Londres, están dispuestos para mostrar como sus varios productos llenan las exijencias de las industrias locales. Los señores Chance Brothers & Co., Ltd., de Birmingham, exponen proyectores para busca y para iluminación, y Alexander Shanks & Son, Ltd., de Westminster, muestran una selección de cortadores de césped; Fleming, Birkby & Goodall, de Halifax, han arreglado un escaparate para exponer tres correas "Teon," las que trabajan en un ambiente lleno de vapor, calentado por un chorro de gas en un extremo, y con una corriente de agua derramada sobre ellas, respectivamente, y Watson, Laidlaw & Co., Ltd., de Glasgow, exponen hidro-extractores. Las bombas "Mopump" centrífugas y motores están expuestas por

Rhodes, Brydon & Youatt, Ltd., de Stockport, y la Mercury Truck & Tractor Company, de Victoria-street, en Londres, muestra fotografías de sus tractores y vagonetas. The Chesterfield Tube Company, Ltd., de Chesterfield, expone caños y tubos sin juntas o costura estirados en frío, caños "Peroma" y varios cilindros de acero, y Wingate's, Ltd., de Grosvenor-gardens, en Londres, expone mezcladores de concreto, etc. Los relojes para obreros y otros por toda la Exposición, han sido suministrados por los señores Gent & Co., Ltd., de Leicester. E. Green & Son, Ltd., de Wakefield, exponen economizadores y calentadores de aire, y la Staveley Coal & Iron Company, Ltd., de Chesterfield, muestra caños de hierro fundido, lingotes, y carbón y productos químicos.

The Acton Precious Metals Refinery.

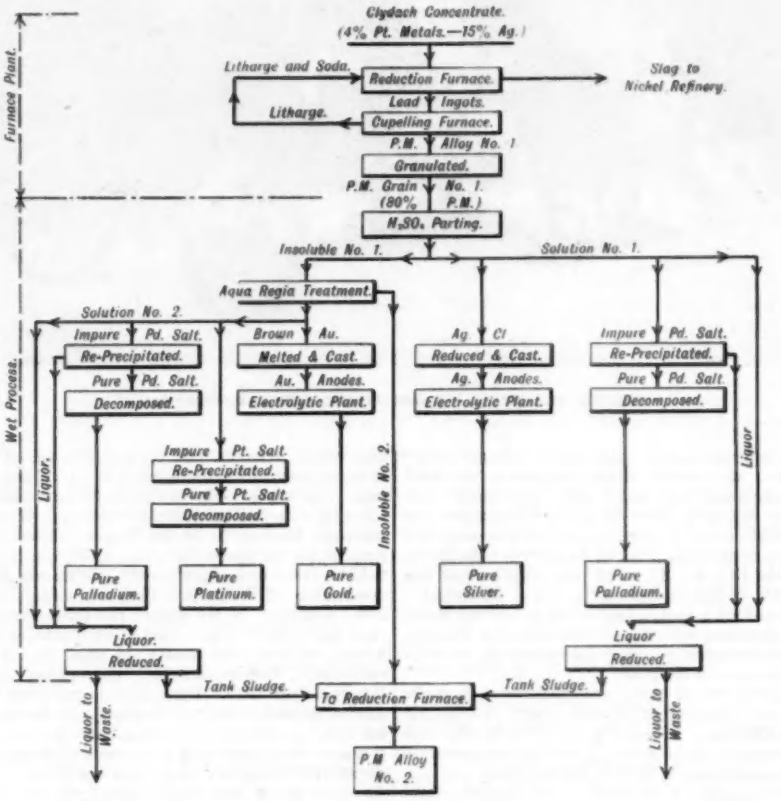
AN event of very considerable interest and of wide economic significance took place yesterday in North Acton, a region which is rapidly becoming industrialised and is already the site of a number of well-equipped and thoroughly modern factories, and engineering and metallurgical works. This was the opening of the new extension of the Acton Precious Metals Refinery of the Mond Nickel Company, Ltd. The opening ceremony itself was followed by a luncheon, at which Lord Weir presided, the Government being represented by the Rt. Hon. J. H. Thomas, Secretary of State for the Dominions, and the Dominion of Canada by the Hon. G. H. Ferguson, High Commissioner. The Mond Nickel Company and its associated undertakings and interests were represented by Lord Melchett, Sir Harry McGowan (chairman of Imperial Chemical Industries), Mr. R. C. Stanley (president of the International Nickel Company of Canada), and Mr. D. O. Evans, Chairman of the Mond Nickel Company, Ltd. Other guests included Sir Harold Carpenter, Dr. Rosenhain, and Dr. Sydney Smith (Chief Assayer of the Royal Mint).

The Acton Precious Metals Refinery was built in 1924, primarily to refine the concentrates from the carbonyl process of nickel reduction—the Mond process—carried out at the Mond Nickel Company's works at Clydach. These concentrates carry about 4 per cent. of platinum metals. The refinery was designed, and the refining process worked out by the technical staff of the company. It has since proved capable of dealing with a far wider range of concentrates, while refining operations have also been carried out on crude platinum from South Africa. Of late, rich concentrates from the electrolytic nickel refinery at Port Colborne, Ontario, have been treated at Acton, and recent developments in Canadian nickel production have led to the necessity of dealing with ever-increasing amounts of these concentrates, which carry as much as 50 per cent. of platinum-group metals. It is for this reason that the recent extensions have been made.

THE PRODUCTS.

Last year some 80,000 oz. (Troy) of platinum-group metals were recovered and refined at Acton. The capacity of the plant, as enlarged, will be 300,000 oz. per annum. The final products comprise platinum, palladium, rhodium, ruthenium, iridium, gold, and silver, but in the above estimate only the platinum group metals are included. A little osmium is produced at Acton, but the main supplies of concentrates do not carry this constituent or insignificant amounts only. The estimated world consumption of platinum-group metals proper is 400,000 oz. annually. It will be seen therefore that the Acton refinery has an output capacity equal to three-fourths of the world demand. The proportions in which during 1930 the various constituent metals of the group were produced were :—Platinum, 47 per cent.; palladium, 39 per cent.; rhodium, 4 per cent.; ruthenium, 2 per cent.; and iridium, 1 per cent. The gold proportion was 7 per cent. These proportions will naturally vary within somewhat wide limits, with the nature of the ores originally treated for their nickel and copper contents. In the near future the Canadian ores from which the concentrates are to be treated at Acton will, it is anticipated, yield about 40 per cent. each of platinum and of palladium, about 7 per cent. of rhodium, ruthenium, and iridium, and about 13 per cent. of gold. The Clydach concentrate contains a high percentage of silver and lead, which, as will be seen later, facilitates greatly the preliminary stages of the refining operations.

The interest attaching to the Acton refinery appeals primarily to metallurgists and chemical engineers. The refinery is, however, from an engineering point of view, exceedingly interesting as well, and is a remarkable instance of the adaptation of materials and design to the provision of an admirably compact factory in which the sequence of operations has been planned to be largely automatic, and in which labour has been reduced to the strictly essential minimum. Including a technical staff numbering about a dozen, the number of persons employed only just exceeds 100. The advance of metallurgical science and the development of a vast number of new alloys have, moreover, rendered it increasingly difficult to draw any definite line of demarcation between precious metals, and industrial and engineering metals and alloys. Silver is being increasingly used in chemical plant, and some of the potentially useful palladium-silver alloys will find applications on a still larger scale when supplies of the now rarer constituent become more plentiful. Platinum and palladium sponge are being extensively employed as catalysts, in many important industrial operations, while platinum-gold or palladium-gold spinnerets are used in the viscose process for the manufacture of artificial silk. The reflecting power of silver is already turned to account in making searchlights and reflectors of all kinds. It has the disadvantage, however, of tarnishing rapidly and requiring, therefore, constant attention. Platinum, palladium and rhodium have before them a wide field as plating materials, being both corrosion and heat resisting to a high degree. Taking the reflecting power of a highly polished silver mirror as 100, that of rhodium is 70, while platinum and palladium both range round about 60, with the added advantages of hardness and non-tarnishing. The electro-deposition of either of these metals on, for example, copper, affords a plating free from all pitting or porosity, and of a far warmer and more beautiful appearance than the popular chromium finish of to-day. Alloys of the platinum group metals and coatings of the actual metals themselves have thus potential engineering applications which await development as soon as their supply at reasonable economic costs becomes available. In electrical engineering platinum contacts are far more effective and durable than any of the platinum substitutes, the use of which in the past has in the main been due to the relative scarcity and high cost of platinum itself.



NOTE:-
P.M. Alloy No. 2 is returned to Wet Process Treatment and its Insolubles and Reduction Residues are worked up to a 50% Rhodium, Ruthenium and Iridium Concentrate, which is resolved in the Process Laboratory.
"THE ENGINEER"

FLOW-SHEET OF THE OPERATIONS AT THE ACTON REFINERY

THE PROCESS.

Reference to the flow-sheet of the operations carried out at Acton shows that in the case of the Clydach concentrates, which, as previously mentioned, contain a relatively large proportion of lead and silver, the first stage involved is their reduction, the lead acting as a collector of the precious metals. This initial smelting operation is carried out in small oil-fired, basic-lined tilting furnaces of novel design. These are housed in the furnace building. The fumes from the furnaces are collected and scrubbed, a precaution necessary in any case, but one which, in this particular instance, not only complies with lead process regulations as imposed by the Board of Trade, but results in the recovery from the fumes of more than sufficient of the precious metals to defray the expenses of the operation. The product of the reduction furnaces is subsequently treated in cupellation furnaces, where the excess of lead is removed in the form of litharge, to be used over again in the smelting of further reduction furnace charges. The product of the cupellation furnaces, which are housed in the same building, is a silver-rich alloy which carries practically the whole of the precious metals. This alloy, which is known as P.M. 1, is then granulated. It is four times as rich in silver and platinum metals as the original Clydach concentrate, which contains 15 per cent. of silver and 4 per cent. of platinum metals. It is known as P.M. grain No. 1. With the production of this grain metal, which carries 60 per cent. of platinum metals, the dry process is concluded, and the grain is next dealt with by the "wet process" in the wet process house adjoining.

It is to this building that the principal extension of the Acton Precious Metals Refinery has been made. The building itself has been doubled in length. It is a lofty well-lighted and perfectly-ventilated construction laid out in a series of terraces steeply stepped one below the other, each tier being equipped with a number of large earthenware pots, specially lined according to the nature of the operations for which they are destined. The materials employed comprise chemical stoneware, vitreosil, porcelain, glass, fused silica, hard and soft rubber, chemical asphalt, and lead, both of the ordinary and of the homogeneous kind. Some of the pots act as filters, while the function of others is to dissolve or digest the various precipitates formed in successive stages of the reactions. For making perfectly sound air and liquid-proof connections between the pots and their covers the contact surfaces are ground, and an ingenious device has been adopted. A semi-circular groove is formed on the outside pot, and another, immediately opposite thereto, on the inside of the cover. Into this groove fits loosely, and before the cover is placed in position, an ordinary deflated india-rubber tire inner tube. When the cover is put on the tire is blown up with a bicycle pump, making a perfectly staunch joint. This eminently practical method was devised by Major C. Johnson, the refinery manager, to whom, indeed, the entire design of the plant, as well as of the refinery as a whole, is due, and under whose direct supervision the original factory as well as the recent extensions have been planned and built.

THE WET PROCESS.

The wet process house is a large-scale laboratory, the various reactions following one another in sequence, and being facilitated by the terraced arrangement of the pots, which, once the materials, acids, &c., used have been delivered on to the highest terrace, proceed naturally in a gravitational direction from above, downward. The materials of construction have been carefully selected. The steel roof girders and trusses are painted with Ferrobit damp and corrosion resisting paint; the window frames are covered with homogeneous lead, and all hand rails, standards, pipe connections, &c., and exposed parts generally are covered with rubber. All unnecessary ledges have been avoided. The floors are paved with Proderite tiles, and the walls are of encaustic tiles pointed with corrosion-resisting cement, further protected by a wash of water glass. At frequent intervals the whole house is thoroughly cleaned, all dusts and residues being duly recovered, so that working losses are reduced to a minimum.

Indeed, the overall losses in the refinery as a whole are no more than ½ per cent. of the precious metals treated; 2½ per cent. is temporarily retained in furnace slags which are returned to the nickel refinery for retreatment; 97 per cent. of the original precious metal content is actually recovered as refined metal. Taking the original content of the ores treated in Canada for their nickel and copper, together with the subsequent recovery processes to which the concentrates, electrolytic sludges, &c., are subjected, it is estimated that 90 per cent. of the associated precious metals is recovered.

The first stage of the operations carried out in the wet process building, when working on concentrates of the kind received from Clydach—and operations on the richer concentrates, electrolytic residues, &c., from Port Colborne are conducted on almost precisely the same lines and in much the same sequence—is the parting of the grain metal produced as the last stage of the furnace plant treatment. This parting is effected by means of sulphuric acid, which is cheaper to use than the nitric acid which has to be employed for parting alloys containing precious metals, together with much lead. The flow sheet shows how the insoluble residue from the sulphuric acid parting is separated from the solution. The former contains practically the whole of the gold and of the platinum and part of the palladium. The rest of the latter and the whole of the silver pass into solution at this stage, both to be recovered later in a pure state.

Insoluble No. 1 from the sulphuric acid parting is next digested in *aqua regia*—and this treatment is incidentally the first stage of the treatment by which wet recovery is applied to the rich electrolytic concentrates from Port Colborne. Most of the platinum, palladium, and gold pass into solution; residual insolubles, and other reduction residues and final insolubles are remelted in order to concentrate the rhodium, ruthenium, and iridium present. These constituents are known as the "by-metals," and are present in the original concentrates to the small extent of 0·4 per cent. only. The resulting alloy, which is known as P.M. No. 2, is returned for a further wet process treatment, the products from which undergo final purification in another department of the refinery. From the liquor from the *aqua regia* treatment the platinum is precipitated as platinichloride, while the palladium is precipitated as palladosammine chloride. This chloride, as the result of precipitation from the solution from the sulphuric acid parting is also obtained during the sequence of operations which colaterally involve the precipitation of the silver, as silver chloride. With these operations the wet process may be regarded as completed, apart from the by-passing of some of the liquors for retreatment or reduction by other methods. The "brown gold" from the *aqua regia* treatment is melted and cast into anodes for the production of pure gold by subsequent electrolysis. This, too, is the penultimate stage of the silver recovery, after reduction of the chloride obtained as above. Electrolytic silver, in fine crystals, has a very high degree of purity and gains little or nothing in this respect from further handling. Nevertheless, "the trade" insist upon being supplied with granulated silver, which means remelting the electrolytic silver crystals in small gas-fired furnaces, and pouring the molten metal into water.

Final Treatment.

The final stages in the production of the pure precious metals, platinum and palladium, are carried out in two other departments of the Acton refinery, the drying oven house and the ignition room. In the former, trays of the platinichloride and of the palladosammine chloride are carefully dried off in gas-fired ovens, the temperature of which requires watchful control. In the ignition room the precipitates of both metals are burned off in similar but more highly heated ovens. Gas firing is resorted to, as the acid fumes from the chlorides render electrical heating practically impossible, and it is, moreover, cheaper. In the case of both metals, sponge is produced, this being the form in which they are marketed to the remelters. The remelting and ingoting of the metals is not carried out at Acton.

The cooling off of the sponge metals, particularly in the case of palladium sponge, is an operation involving care. Palladium on cooling down to about 750 deg. Cent. is prone to oxidation with the formation of a purple oxide. Cooling is therefore effected in an atmosphere of hydrogen.

Two other departments of the Acton refinery need mention. These are the electrolytic silver room and the electrolytic gold room. In the former, electrolysis is at present conducted in two fairly large earthenware vats; the comparatively impure anodes deposit the pure silver crystals on pure silver cathodes. In the gold precipitation room is a range of small vats, with gold anodes and cathodes, which are suspended from silver bus-bars.

The process steam used throughout the factory is supplied from a Penman marine type oil-fired boiler, while in the power-house is installed a high-pressure vacuum pump air compressor by Mather and Platt, and a Mather and Platt six-phase, 50-cycle rotary converter, fitted with the firm's patented oscillating motion for reducing wear on the commutators.

Modern metallurgical research on the influence of impurities on metals and alloys has involved the preparation of metals possessing initially a very high degree of purity, so that the perturbing influences of other substances accidentally present can be eliminated, and the ascertained results of adding one metal to another duly assigned to the proportions employed. The degree of purity to which the platinum metals are refined at Acton may be gauged from the following figures:—

Fineness of the Platinum Group Metals Refined at Acton.

	Per cent.		Per cent.
Platinum	99·93	Rhodium	99·7
Palladium	99·94	Ruthenium ..	99·7
Iridium	99·97	Gold	99·97

Silver 99·97 per cent.

The uses of the precious metals in industry tend to increase in proportion as their supply becomes more plentiful and their cost lower. From many points of view they may already be regarded as industrial metals, for the line of demarcation between "precious metals" and alloys and those used in the newer developments of special branches of engineering and chemistry and in the construction of physical apparatus becomes increasingly difficult to draw. Extensive investigations, both on the pure and the applied metallurgy of the platinum group metals and their alloys, are being constantly carried out by the technical staff at Acton, and practically the whole of the upper floor of the main office building is given up to a range of exceedingly well-equipped laboratories for routine testing and for research. It has, indeed, been largely in these laboratories that the processes carried out in the refinery itself have been studied and brought to their present perfection. Investigations in progress may be expected to widen greatly the uses of the platinum group metals, and particular attention is being devoted to methods of plating them on other metals, to which reference has already been made.

The Acton Refinery has, in addition to the usual office buildings, sections devoted to the safety and convenience of the workmen, and these comprise spacious and well-ventilated changing rooms, in which damp clothes, overalls, &c., can be cleaned and dried, and a canteen. Process steam is used for heating, and the ventilation of all buildings in which noxious fumes may be emitted ensured by an elaborate system of induced draught. A range of strong rooms is provided for the finished products of the refinery, and these are adequately guarded day and night.

From the economic point of view the success of the refinery seems amply secured. The materials refined may be regarded as costing nothing; the ores from which the concentrates and residues are derived have already repaid, many times over, with the nickel and copper they contain, the cost of mining, smelting, and refining primarily for the production of those metals. The further recovery of their precious metal contents at Acton is estimated to cost approximately 10s. per ounce of metal recovered. The price of the sponge metals produced varies widely, but even with the present low prices prevailing for platinum and palladium—which are likely, incidentally, greatly to increase the demand for the former and to lead to its use being reverted to in, for example, electrical engineering applications, in which hitherto "substitute metals" have been employed—handsome profits are assured from the operations of recovery and refinement. The prices of the other metals of the group fluctuate widely, but are always substantially higher than those of platinum and palladium. With their supply assured, new uses will be found for all of them, while with the conditions under which the Acton Precious Metals Refinery has come into being, and with the powerful backing it has in the Mond Nickel Company, Ltd., in the International Nickel Company of Canada, and in the allied interests of the latter powerful organisation, and lastly with the assured continuity of the supplies of concentrates, not even the potential menace of cheap platinum from the Urals is likely to endanger the prosperity of this great enterprise.

In conclusion, we wish very warmly to express our thanks to Mr. D. O. Evans, Mr. A. C. Sturney, and to Mr. Sidney Rogerson, of the Mond Nickel Company, Ltd., Imperial Chemical House; to Major C. Johnson, M.B.E., the refinery manager at Acton; and to Mr. R. H. Atkinson, assistant refinery manager, for the facilities so freely accorded us to visit the works. On page 460 some views of the refinery are reproduced.

Institution of Mechanical Engineers.

The final meeting of the Institution of Mechanical Engineers for the current session, held in London last Friday evening, was distinguished by the excellence of the paper presented at it, "Post-war Land Turbine Development," by Mr. C. D. Gibb, of Messrs. Parsons; by the admirable manner in which the author summarised in a matter of about 20 min. the salient points of his lengthy paper; by the surprisingly small audience which assembled to hear it; and by the still more surprisingly small number of those present who desired to discuss it. Equally noteworthy was the absence of any serious criticism of the author's remarks and the completeness with which Mr. Gibb accepted or agreed with such criticism as was forthcoming. In brief, the paper was too good to provide the basis for a good discussion. We begin a reprint of it elsewhere in this issue.

Mr. F. Samuelson, of the B.T.H., Rugby, was invited by the President, Lieut.-Colonel E. Kitson Clark, to open the discussion. Mr. Samuelson began by asking the author to correct certain figures in Table I. relating to Item 55, the B.T.H. 10,000-kW turbine at the Delray station. As Mr. Gibb subsequently accepted the corrections, we have inserted them in the table. Mr. Samuelson also suggested that the table might be extended by the addition of another item No. 64, namely, particulars relating to the 75,000-kW B.T.H. turbine at Barking. As Mr. Gibb expressed his complete willingness to do so, we have added the figures given by Mr. Samuelson to the table as reprinted in this issue. In connection with item No. 55 in the table, the 10,000-kW B.T.H. turbine for the Detroit Edison Company designed to operate at an initial steam temperature of 1000 deg. Fah. and a stop valve pressure of 365 lb., Mr. Samuelson said that the set had now been six months in commercial operation, but the highest temperature so far used was only 700 deg. It had been found difficult to obtain superheater tubes that would withstand a temperature of 1000 deg. That difficulty had now been practically overcome, and it was expected that by June the set would be running with the designed steam temperature. Passing to the question of reheating the steam between the stages, Mr. Samuelson characterised it as a troublesome subject. The future alone, he said, could decide whether it was better to raise the initial temperature or to increase the pressure and employ reheating. He himself favoured increased initial temperatures, for by their adoption the complications inherent in a reheating system were avoided. According to the author, the 50,000-kW Parsons turbine installed at Dunston in 1930—Item 25 in the table—was to employ a system of reheating by means of the flue gases from a combined reheat and normal evaporation boiler. He would like the author to state whether there would be more than one such boiler in the boiler-house. If there were only one and if it went out of commission, the low-pressure turbine deprived of its reheated steam would clearly have to operate at reduced efficiency. It would be interesting to learn in time how the scheme described by Mr. Gibb for providing safety devices for reheat turbines worked out in practice. He hoped that in due course figures would be given which would enable turbine designers and users to determine whether reheating was justifiable, not only from the point of view of thermodynamic efficiency, but from the standpoint of what Americans called "dollar efficiency." Discussing the tightening of bolts by heating them instead of resorting to the crude practice of "flogging" them up, he said that many years ago the B.T.H. Company had tried an electrical method of heating the bolts after the manner described by Mr. Gibb. The process had, however, been found very slow and at Rugby gas heating was now employed. Concluding, he commented on the fact that little work had been done in this country on high-pressure steam turbines. It was widely held that it did not pay to use pressures above about 600 lb. It would therefore be of interest to note that at Rugby his company was making a 30,000-kW turbine designed to use steam at 1200 lb. pressure, a figure which was quite equal to that found in recent American practice.

Mr. A. H. Fitt, of Messrs. Allen, Bedford, supplemented the information in the paper by reviewing the developments that have been made during the period covered by the author in turbines of the smaller sizes used for various industrial purposes and for driving auxiliary equipment on ships. Steam pressures, he said, had advanced from about 250 lb. to about 600 lb., and temperatures from 550 deg. to 850 deg. Fah. His firm had built a number of turbines for pressures of 500 lb. to 600 lb., and had quoted for industrial plant at pressures up to 1200 lb. Dealing with the question of erosion, he remarked that a great amount of erosion could take place on the inlet edge of the blades without a serious loss of efficiency being incurred, as had been proved by tests made with blades the edges of which had been deliberatley rounded. He agreed thoroughly with Mr. Gibb concerning the necessity for examining the interior of rotor shafts by trepanning a hole through them. In the course of his firm's experience, two defective shafts had been discovered by that method. Such a small percentage of faulty material might seem to suggest that the provisions made for detecting it were disproportionate to the ends achieved. But, as the author had remarked, serious accidents had happened in the past to turbines, and manufacturers were anxious to take all possible steps to prevent their repetition. It was now his firm's practice to make the top end of the ingot the non-driving end of the rotor shaft, in order that any defects, such as piping, might be situated at a point of no stress. He agreed with the author as to the necessity for dry-finishing the bore-holes in shafts. If lubricant were used for the cut the smoothness of the surface increased the difficulty of detecting flaws. Continuing, he discussed the question of vibration and expressed the opinion that it was, perhaps, the most serious trouble with which the turbine designer had to deal. There were many causes that might lead to vibration. One, not always sufficiently appreciated, was priming in the steam. Operators were frequently not careful

enough with the feed and at times failed to appreciate the necessity for warming up the turbine properly before setting it to work. The warming up should be done with high-pressure steam and not with back pressure steam. There were occasions on which it was very difficult to discover the cause of vibration in turbines. In one instance of which he knew, many steps were taken to eliminate vibration, including the replacement of a nickel steel shaft by a mild steel shaft. The trouble was cured, but what had caused it, or which of the steps taken to eliminate it had been decisive, was never satisfactorily determined. Concluding, he commented on the fact that welded construction had not been touched upon by Mr. Gibb. Steel castings were not an unmixed blessing and were frequently the cause of delay in the manufacture of turbines. Welded construction, in his view, was bound to become widely adopted.

Mr. I. V. Robinson, of the B.E.A.M.A., said that Mr. Gibb had made no reference to Sir Charles Parsons' paper before the World Power Conference in Berlin last year, in which the great economy of using turbines with a high overload capacity was demonstrated The normal overload capacity of a turbine was about 25 per cent., but Sir Charles showed that a good argument could be established in some cases for installing turbines capable of carrying 75 per cent. above their most efficient load. The advantage lay in the fact that the extra 50 per cent. output could be obtained at much less capital cost in a high overload turbine than by installing an additional turbine of the equivalent size to take the peak load. There were likely to be developments soon in that direction. Already, in America, there was a plant with a rating of 80,000 to 90,000 kW at the point of maximum economy, which could take an overload up to 160,000 kW. Discussing the particulars given in Table I. of the paper, he asked whether there was really any need for the large machines recently installed in the United States—160,000 at East River, 165,000 at Hell Gate and 208,000 kW at State Line. In what way was the last-named station better off than it would have been with three 70,000 kW turbines? The Americans themselves did not seem to be all of one mind on the subject. For example, at Detroit there were in one station thirteen units of 50,000 kW each, although large units could have been used quite readily. Turning to the subject of the materials used in turbine manufacture, he remarked that it was now the general practice of British makers not to use cast iron at any point at which the temperature exceeded 450 deg. Fah. Endeavours had been made to secure the recognition of that limit in the International Turbine Specification, but very considerable opposition to its adoption had been encountered from Swiss and German engineers. It was stated that in their countries they were using something which was called cast iron, but which had properties nearly the same as those of cast steel. No temperature limit to the use of cast iron was, therefore, laid down in the International Specification.

Professor A. L. Mellanby, of Glasgow, said that in the United States he had been struck by the extensive degree of co-operation which existed between turbine manufacturers and turbine users. In the stations large technical staffs were maintained for investigating day-to-day problems, making tests, analysing the results and seeking directions in which improvements could be effected. Discussing the question of temperature and pressure, he expressed the opinion that as time went on it would be realised that there was an economical limit to the pressure that might be used, and that the gains to be derived by taking the pressure above 700 lb. or 800 lb. were very small. The problem of reheating was so intimately connected with the pressure that it could not be discussed separately. Thermodynamically the gain derived from reheating was not very great. As regarded the superheating of the steam, it was frequently asked why we did not go to a total temperature of 900 deg. or 1000 deg. Fah. The answer was that it took some doing and that it was not the easy thing which some people imagined it to be to work a superheater continuously at those temperatures. He believed that a temperature of 700 deg. to 800 deg. Fah. would be found to be ample. Reliability was a subject which had to be considered. Mr. Gibb had referred to the accident at Shanghai in 1923. More recently there had been a serious accident at a Glasgow station, although fortunately there had on that occasion been no loss of life. The problem of securing reliability was a difficult one, but it was one that had to be faced however much its solution cost in the way of increased expenditure on forgings.

Mr. H. E. Yerbury remarked that the author had dealt with erosion, but had not mentioned corrosion. Much trouble was experienced by station engineers as a result of corrosion at or about the dew point. Happily, the same alloy steels which minimised erosion also minimised corrosion. The method described by Mr. Gibb for tightening bolts by heating them appeared simple and effective, but to station engineers the difficulty frequently lay, not in tightening, but in loosening the bolts. Cylinder distortion was a cause of serious trouble in stations, and the author's firm was to be congratulated on evolving a design that would avoid it. Mr. Gibb was wise to omit test results from his paper. Reliability was more important than a few decimal points.

Mr. Gibb, replying to Mr. Samuelson, expressed the hope that he would also add to the table particulars of the Ford set, and that the operating results of the B.T.H. high-temperature turbine at the Dalrey, Detroit, station would one day be published. Concerning the Dunston reheating set, he believed that eight of the boilers would be provided with flue gas steam reheaters. The overspeed controls for reheating turbines described in the paper were in satisfactory operation at the Crawford-avenue and Barking power stations. As a means of tightening up bolts heating by gas was probably just as good as the method described in the paper, but as Messrs. Parsons supplied turbines to the electricity supply industry they felt that it would be a shame not to use an electrical method. Mr. Fitt's remarks were interesting as showing that the development of industrial and auxiliary turbines during the post-war period had followed the same lines as in large plants. As at Bedford, it was the practice at Heaton to make the top end of the forging the non-driving end of the shaft. He disagreed with Mr. Fitt concerning the best method of warming up a turbine. The practice recommended by Messrs. Parsons consisted of getting the turbine turning in the cold state and warming it up when it was rotating. Regarding the adoption of welded construction in place of steel castings, his view was that two things were required, courage plus caution. Replying to Mr. Robinson, he said that whether a large unit or an equivalent number of small units were better was essentially a question of the total load on the system. If one system were, say, ten times as big as another there was no reason why the units should not be ten times as large. The proportion of the eggs in the one basket would be the same. He agreed with the limitation of the use of cast iron to points at which the temperature did not exceed 450 deg. Fah. Some sets of which he knew had cast iron steam chests subjected to temperatures of about 650 deg. Fah., but how they did it he did not know. The corrosion at the dew point mentioned by Mr. Yerbury was caused by faulty feed water, as, for example, feed water containing oxygen or carbon dioxide. He did not agree with Mr. Yerbury's remark that the materials which resisted erosion also resisted corrosion. For example, stainless iron had a poor resistance to erosion. High-speed steels which resisted erosion were not very good from the point of view of resistance to corrosion. Concerning the loosening of bolts, he said that it was now his firm's practice to make the nut or the bolt slightly loose on the thread and to spray the bolt thread with aluminium by means of a Schoop pistol. Since that practice had been adopted no trouble had been caused by the seizing of the nuts on the bolts.

Electric Induction Roll Heaters.

WHEN it is realised that about 80 per cent. of the roll breakages in the steel rolling industry are caused by inaccuracy in the temperature conditions, the importance of controlling those conditions is obvious. Before it is put to work the ordinary chilled portion of the roll has a chill from $\frac{1}{16}$in. to $\frac{1}{8}$in. thick and is hard and brittle. The entire centre portion, including the neck and wobblers, is of grey iron cast in sand, and has to be cooled to permit the carbon to assume a graphite form. This composite structure of the roll is primarily responsible for the breakages, but the conditions are made much worse by the fact that usually rolls are heated by means of heat applied at high temperature to the outside, which results in a steep temperature gradient from the outside to the inside of the roll. Thus it will be seen that the method of first heating up a roll to the temperature which results from the process of rolling hot sheets is of vital importance.

Another difficulty which arises is that the process of making a chilled roll results in great stress in the roll, and these stresses may be very unequal in different parts. While opinion has been divided on the desirability of attempting to relieve these casting stresses in the foundry, on account of the fact that any method of applying heat from the outside is liable to aggravate the trouble, the electric induction method, described in this article, is said to be able to relieve the stress with perfect safety. In rolling hot sheets the middle portion of the roll becomes hotter than other portions, and therefore expands more than the ends, and in order to ensure that the rolls shall be of the correct shape for rolling sheets of even gauge they are turned or ground concave when at normal air temperature so as to allow for the greater expansion at the middle at rolling temperature.

Various methods have been tried to bring about the initial heating. As a means of getting the heat into the rolls narrow heavy-gauge sheets can be rolled, the widths being gradually increased as the roll heats up until the roll is hot enough and has the correct difference in temperature between the middle and ends to allow the full width sheets to be rolled. But besides taking several hours, and consequently resulting in loss of production, this method gives rise to a great deal of scrap. When a certain amount of narrow or band iron has to be rolled the work is best done in a separate mill using rolls that are too badly worn to be used for other purposes. As the rolls are being subjected to rolling shocks while expanding owing to the rise in temperature, the method of heating described is very liable to result in roll breakages.

Another method is to bring gas or oil flames or electrically heated resistance elements into contact with the roll before rolling, but this involves applying heat at high temperature from the outside, and although the roll is not subjected to rolling shocks during the heating process, owing to the steep temperature gradient, fracture is liable to occur. It is probably true to say that the majority of roll breakages, apart from those caused by accident, are brought about by the first heating. Although the rolls may not break at the time of heating, damage is done, and days or even weeks may elapse before the real trouble is experienced. Many rolls have been broken when all working conditions appeared perfect, and the explanation probably is that the roll received a fracture when it was first heated up and that the fracture extended and ultimately

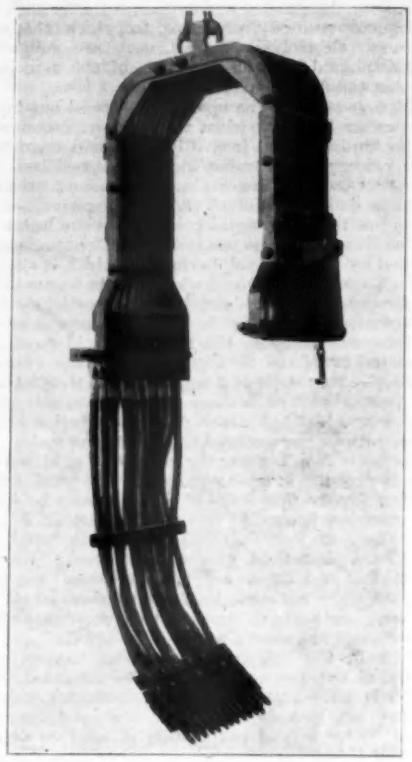


FIG. 1—ROLL HEATER OPEN

led to complete failure. Tests carried out by the United States Steel Corporation a few years ago showed that a chilled roll had the greatest resistance to breakage stresses at temperatures between 180 deg. and 400 deg. Cent., and a roll should not therefore be used until the temperature has been raised above the lower limit and should not be allowed to exceed the top limit when in use. The increased risk of breakage before the roll has settled down to its normal working temperature is well illustrated by the following analysis, which shows the percentage of rolls broken on various days of the week at three different works where the rolls were not preheated.

Rolls Broken.

	Works No. 1. 25 mills, seven months, Per cent.	Works No. 2. 14 mills, nine months, Per cent.	Works No. 3. Per cent.
Monday	32	40	25
Tuesday	20	30	20
Wednesday	15	12½	20
Thursday	15	17½	17
Friday	15	2½	13
Saturday	3	2½	5

Realising the dangers of breakage involved in heating

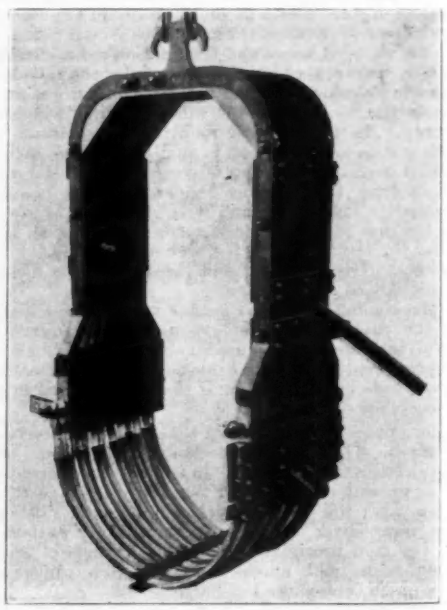


FIG. 2—ROLL HEATER CLOSED

rolls by the usual methods, and in order to make use of a method of heating which does not require a high-temperature heat to be applied externally to the roll, Mr. K. Younghusband has invented and patented a form of roll heater which uses the principle of electric induction to create heat in the roll itself. The manufacture of this new

EQUIPMENT FOR HEATING ROLLS BY ELECTRIC INDUCTION

ENGLISH ELECTRIC COMPANY, LTD., LONDON, ENGINEERS

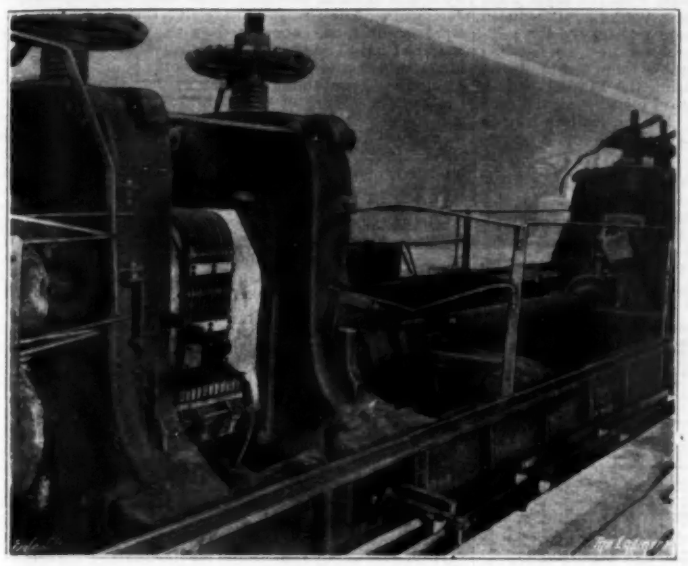


FIG. 3—ROLL HEATER ON MILL

FIG. 4—TRANSFORMER AND BUS-BARS FOR ROLL HEATER

type of heater on a commercial scale has been undertaken by the English Electric Company, and the success which has attended the installation of a number of equipments is said to have created widespread interest in the rolling industry. While remaining cool itself, the heater gradually raises the temperature of the roll without producing a steep temperature gradient between the surface and centre, and also builds up the heat in the correct proportions from the middle to the ends, so as accurately to copy the normal heat distribution and gradually to bring the roll to the correct shape for rolling sheets. The principle involves surrounding the pair of rolls with a coil of wire carrying an alternating current which induces currents in the mass of metal contained in the rolls and so generates heat in the metal. The roll heater with the connecting cables open is shown in Fig. 1, whilst Fig. 2 shows the same heater with the connections closed so as to form a coil. It will be perceived that the heater consists of strips of copper wound on edge with the lower ends connected by flexible cables and that the whole is braced together and supported on two rods which are placed over the rolls. A roll heater on a mill and connected by a cable to the terminal board is shown in Fig. 3, from which it will be gathered that the heater is simply lowered into position by a crane, the width of the heater being less than the distance between the two wheels of the screw-down gear. The rolls are covered with a sheet of asbestos cloth, which reduces heat loss by radiation from the rolls and at the same time protects the heater from the heat.

Since no energy in the form of heat is transferred from the heater to the rolls, the heater itself remains comparatively cool. The heater is supported on rods clear of the mill, so that although the mill can normally be at rest—and the heating is perfectly uniform around the circumference—if necessary one mill of a drive can be in use and another may be put into service with the heater on the revolving rolls. Owing to the friction of the roll necks it is found in practice that the temperature of the roll is brought up to the working value by the electric heater in a shorter time than when the mill is at rest. The heater can be placed in position or removed within a few minutes, for all the coil connections are made by tightening a single bolt and none of the mill fittings need be removed. Experience has shown that these roll heaters should be supplied with current at comparatively low voltage, and a transformer is therefore normally required for stepping down the works pressure to about 100–120 volts, the arrangement of the transformer depending on the number of roll heaters in use in one line of mills. If, for example, six heaters are required, the transformer would be of the three-phase type, one or two heaters, according to whether three or six heaters are in use, being connected to each phase. If there were eight mills the transformer would be Scott connected to give a two-phase supply and two or four heaters would be connected to each phase.

Each heater takes approximately 50–60 kW to raise the temperature of a pair of rolls 42in. by 30in. diameter to 300 deg. Cent. in twelve hours, and therefore consumes 600–720 units, the necessary transformer capacity being 100–120 kVA. The heaters are suitable for 40, 50, and 60-cycle systems, but have not yet been developed for use on a 25-cycle system. Preferably the transformer is placed midway along the mills, and is connected to bus-bars under the floor plates. Hand holes are made in the vertical plate alongside the mill bed and opposite the mills, and connecting lugs are provided in the hand holes in ambush so that nothing that can be damaged projects into the mill-race. A transformer in position and protected by a coaming around it is shown in Fig. 4, which also shows the bus-bars, which are normally covered by iron plates. Two ironclad pillars for controlling the 2000-volt, 50-cycle, three-phase supply to the transformer and two of the roll heaters on the storage racks adjacent to the mill are shown in Fig. 5.

The temperature rise of a pair of 30in. diameter by 42in. rolls is recorded in Fig. 6. In the rolls holes were drilled to various depths and temperatures were taken with a view to arriving at the heat distribution in the roll and the temperature gradient between the surface and the centre. At corresponding distances from the middle the temperatures were equal on both rolls around the surface, there being no need to revolve the rolls to get equal heating. The natural temperature fall from the middle to the ends of the rolls under working conditions and for rolls of different lengths and the corresponding gradient produced by the electric heater are shown in Fig. 7, which indicates how closely the gradient produced by the electric heater copies the natural one.

With regard to the economies to be realised from any new scheme, it is always better to be able to give actual results than to quote estimated economies. The following table, which gives results of 30 mills on four drives and covers a full year's working, shows clearly the reduction in roll breakages, the decrease in the scrap per ton rolled on the first shift, and the increased production of the mill on the first shift owing to the adoption of electric heating. All rolls are included, whether accidentally broken or not, and chipped rolls that were scrapped are included. The table covers twelve months, *i.e.*, January to December, 1930:—

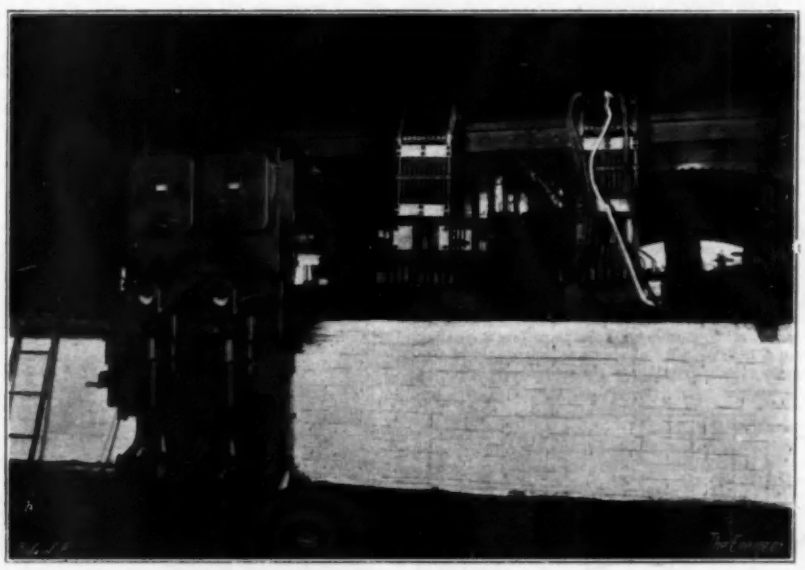


FIG. 5—CONTROL PILLARS AND HEATER STORAGE RACK

	No. 1 engine. Seven mills.		No. 2 engine. Seven mills.	No. 3 engine. Eight mills.	No. 4 engine. Eight mills.
	7½ months to August 16th, unheated.	4½ months, oil heated.	Unheated.	Unheated.	Electrically heated.
Rolls broken	22	10	29	26	15
Rolls chipped	3	—	2	5	3
First day. Rolls broken	9	4	9	8	4*
chipped	2	—	—	—	—
Production	21,561	9,652	31,436	29,760	28,724
Broken rolls, cost per ton	2s. 6d.	2s. 11d.	2s. 5d.	2s. 2d.	1s. 4d.
Total rolls, cost per ton	2s. 11d.	2s. 11d.	2s. 7d.	2s. 8d.	1s. 7d.
		t. c. q. lb.	t. c. q. lb.	t. c. q. lb.	t. c. q. lb.
Average first shift, scrap per ton	—	0 3 2 20	0 3 3 3	0 3 3 13	0 3 2 0
Average first shift, tons per mill	—	5 15 0 0	5 15 0 0	5 11 0 0	6 5 0 0

* 1, pack fast; 2, change of shift; 1, used elsewhere.

There is a saving of 1s. 1d. to 1s. 4d. per ton rolled owing to the rolls alone, and on an output of 30,000 tons a year this will amount to £2000 per annum, which is far greater than the initial cost, and the annual power consumption of the whole heating installation. It will be observed that the scrap saved per ton in the first shift does not appear to be very great, the difference being from 20 lb. upwards in favour of electrical heating, but when multiplied by the tonnage produced during a shift this represents quite a considerable saving of marketable material. It will also be observed that with the electric heaters the first shift gives an output nearly equal to any other shift during the week, owing, of course, to the electrically heated rolls being of the correct shape before rolling is started. When comparing electric heating with oil or gas heating, the makers of the electrical equipment explain, it must be remembered that the former requires no attention and no power for turning the mills, or for auxiliary purposes, the only power needed being that for the roll heater and transformer. With flame heaters constant attention is, of course, required during the process, and this attention has to be paid for at high rates. Electricity is required for barring the rolls round and also for providing compressed air, and even then the results are sometimes unsatisfactory and hardly to be distinguished from those obtained with mills that are not heated at all. Oil heaters should certainly show an increased production on the first shift, but over a period of 4½ months the table does not indicate that there is a very distinct gain in this direction. The oil-heating equipment, we are told, was installed with a view to its permanent adoption,

but after a prolonged test it was abandoned. The capital costs of the electrical equipment are unimportant in comparison with the savings effected, for the loss due to broken rolls is one of the largest items in the cost of sheet rolling. When it is remembered that sheet roll costs from £100 to £150, it will be realised that the loss due to broken rolls may be very considerable.

The preheating only takes place once a week, and with electricity at ½d. per unit the cost is only in the neighbourhood of 2d. per ton of sheets rolled, and, as the roll cost usually amounts to some shillings per ton, it will be seen that even with electricity many times this price per unit, the savings are very appreciable. The same considerations apply to capital cost when compared with the sum of money represented by a roll, the saving of two rolls more than paying for the cost of the heating plant per mill. With electric induction heaters the whole working cost is simply that of the electricity used. There are no attendance charges, no power is required for revolving the mills, and no power or attendance is needed for auxiliaries. The heaters are switched on a few hours before the mills are set to work and the desired results are automatically attained.

Another feature of the scheme is that it provides for the case of a roll being accidentally broken. A spare pair of rolls can be kept at working temperature by heaters working at reduced loading, as shown in Fig. 8, the same transformer being used as is employed at week-ends for heating the rolls in the mill housings. The practice of maintaining spare rolls at the working temperature avoids loss of production and the risk of breakage brought about by starting afresh with cold rolls. In the manufacture of rolls for sheet mills it is desirable to rough-turn them, and then to leave them to weather for a period of from 3 to 12 months, in order to reduce the casting stresses and to enable the rolls to retain their shape when ground; but, in spite of this weathering, it is often found necessary to regrind new rolls to shape after the first shift. But, by utilising the equipment as shown in Fig. 8, it has been found that new rolls which are electrically heated prior to grinding require much less weathering, and that they will retain their shape for a much longer period. This, the makers of these electric heaters explain, is to be expected, since, by heating the roll some of the stresses are relieved and the roll will not distort to the same extent as it would in the absence of the heating process. Moreover, this electrical weathering has the effect of considerably prolonging the life of the rolls, since the first heating is of greater importance than the subsequent heating.

The makers of the equipment summarise the advantages of induction electric heating as follows:—(1) The roll is gradually brought up to the required temperature by heat created in the roll itself, the temperature at the centre being increased at the same time as that at the surface, and the stresses due to a steep temperature gradient are thus avoided; (2) foundry stresses are relieved, and the necessary distribution of temperature between the middle and ends is attained before subjecting the roll to rolling shocks. Normal production is started at once; no narrow iron need be rolled and the production on Monday is as good as the mid-week production, whilst there is an appreciable saving of the scrap on Monday; (4) one or more pairs of spare rolls can be kept hot in separate stands for immediate use in the event of a change of order, or an accidental breakage, with the same plant that is used for ordinary heating working at reduced power; (5) the heaters, which are put on by the millwrights on Sunday in a period of 5 minutes, are handled by the crane, and two men can remove them in 4 minutes; (6) no attendance is needed during the heating period, no power is used during that period for turning the rolls and the mills never start cold; (7) the heaters can be used equally well on a mill that is in motion and a pair of rolls can be heated or be kept hot in a mill while adjacent mills are on production; (8) the rolls are covered to prevent loss by radiation and are protected from cold air currents; (9) the mill train always starts hot and power is saved on Monday morning by the reduced mill friction; (10) as the engine does not run until rolling begins, attendance, power and oil are saved in turning a cold mill; (11) the process is clean, there are no fumes, smoke or steam, and as the process has a demagnetising effect on the rolls, there is no possibility of the rolls picking up iron particles which might damage special sheets, and (12) as the electric power for heating is used at times of "off peak" loads, the current can usually be obtained at low rates. Electric induction heaters have now been in regular use in rolling mills for about two years, and it has been found that the maintenance costs are negligible.

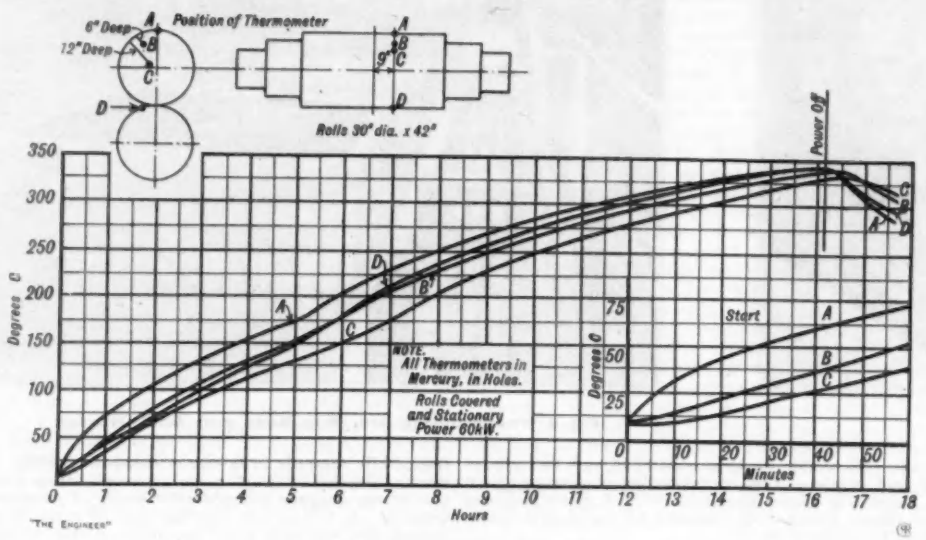


Fig. 6—Temperature Curves

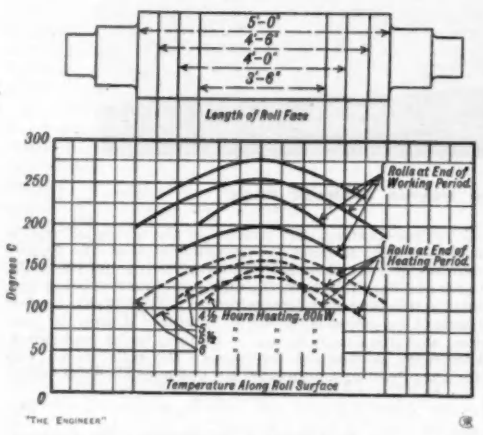


Fig. 7—Curves Showing Temperature Along Roll Surface

Fig. 8—Heaters Applied to Spare Rolls

The Faraday Centenary.

In commemoration of the discoveries in electro-magnetic induction made by Michael Faraday in August and September, 1831, the Royal Institution and the Institution of Electrical Engineers have arranged to hold Faraday centenary celebrations during the week beginning Monday, September 21st, 1931. Government, educational and other authorities have agreed to co-operate, and delegates will attend from the British Dominions and Colonies and from foreign countries.

A Faraday commemorative meeting arranged by the Royal Institution will be held at Queen's Hall, London, on the evening of September 21st, and on the morning of Tuesday, September 22nd, as part of the I.E.E. summer meeting, which will be held from September 22nd to 25th in conjunction with the centenary celebrations, a conference will be held at the Kingsway Hall, London, W.C. 2, when there will be discourses on "The Place of Electricity in the Production and Utilisation of Power, and in Transport, Communications, and the Household." The speakers will include Sir Oliver Lodge, Mr. J. S. Highfield, Miss Caroline Haslett, and Mr. Ll. B. Atkinson.

The Institution of Electrical Engineers will be responsible for the Faraday Centenary Exhibition to be held at the Royal Albert Hall, London, from September 22nd to October 3rd, 1931. This Exhibition, which is intended to demonstrate in a practical manner the benefits which have followed from Faraday's discoveries, is being organised by means of funds provided by the Institution of Electrical Engineers. The Central Electricity Board and the principal associations connected with the electrical and chemical industries are co-operating with the Institution in the organisation of the Exhibition.

Showcases containing Faraday's personal relics will form the central feature of the Exhibition, and on adjoining stands reproductions of Faraday's more important experiments will be arranged by the Royal Institution. The remainder of the Exhibition will consist of displays of the modern applications of electricity which have followed from Faraday's work. These will cover the whole field of the generation, transmission and use of electric power, the latest developments in communications, engineering, radiology, and those sections of the chemical industry which owe their origin to Faraday's discoveries. Arrangements have already been made for many novel exhibits, and it is confidently expected that the Exhibition will be one of exceptional interest.

The Exhibition will be opened to the public by General the Right Hon. J. C. Smuts, C.H., F.R.S., at 4.30 p.m. on September 23rd, and will remain open until the evening of October 3rd. Members of the Institution of Electrical Engineers will be afforded the opportunity of a private view on the occasion of the annual conversazione, which will be held at the Royal Albert Hall on September 22nd. During the morning of September 23rd the Exhibition will also be open for a private view, not only to members of the Institution of Electrical Engineers, but to the delegates to the centenary celebrations, and those taking part in the centenary meeting of the British Association for the Advancement of Science.

A limited number of tickets for members of the Institution of Electrical Engineers will be available for the meetings at Queen's Hall and Kingsway Hall and the private view of the Exhibition. Application for these tickets should be made in August to the Secretary of the Institution of Electrical Engineers, Savoy-place, London, W.C. 2.

SIXTY YEARS AGO.

One of the mechanical wants of the age, so we wrote in a leading article in our issue of April 28th, 1871, was an extremely light steam generator of great power. The nearest approach to such a boiler then in existence was the boiler of a Shand and Mason or a Merryweather fire-engine. These boilers, however, were not only of relatively small power, but their ability to stand up to constant hard work for days and weeks without a stop was a good deal more than questionable. The most efficient steam generator so far constructed weighed about 56 lb. for every indicated horse-power which it could develop. If a boiler could be produced that would give one horse-power for every 20 lb. of its weight, many branches of engineering would be revolutionised. We believed that it was possible to produce such a boiler. The weight of a boiler, we argued, was very largely determined by the extent of its heating surface, and hence in order to produce a generator of extreme lightness we would have to reduce the diameter and thickness of metal of the tubes of which the boiler would necessarily largely have to consist. We would have to use a very intense heat and reduce the surface intended to absorb it. In order to avoid the burning of the metal, it would be necessary to ensure that the tubes were constantly filled with water, and that steam was never allowed to form in them. These and other rules which we established by an appeal to first principles led us to the outlines for the design of an extremely light and efficient steam generator. In such a boiler the heating surface would consist of very thin rolled copper tubes, not more than ¼in. in diameter. These tubes would connect two chambers, both of which, as well as the tubes, would be kept constantly full of water. With one of the chambers a receiver and separator would be connected, into which a regulated quantity of water would flow from the generating tubes. A pump would be provided to keep the water in very rapid motion through the tubes. The velocity of the water created by the pump would be so great that it would sweep away every bubble of steam that might be formed in the tubes or every particle of deposit that might otherwise adhere to the tube walls. The heated water discharged into the receiver would, in part, flash into steam for supply to the engine, and, in part, be returned for another passage through the tubes. On the one side of the tubes, we anticipated, there would be a body of flame at a temperature of at least 2000 deg., while on the other the tube metal would be in very close contact with a hurrying body of water heated at the most to 300 deg. The construction of such a boiler was, we argued, within reach of modern engineering skill. Its efficiency, we were certain, would, weight for weight, far transcend that of any boiler then in use. It is easy in the light of present-day knowledge to criticise the suggested design. It is, however, more seemly to note the manner in which at certain points our ideas anticipated some features now accepted as fundamental.

The Talking Beacon on Little Cumbrae Island.—In a Journal note, published on March 27th, referring to the grounding on March 21st of the Canadian Pacific liner "Montclare" on the Little Cumbrae Island while proceeding up the Clyde estuary, to Greenock, we expressed some uncertainty, from the information then available, as to whether the talking beacon on the island was in operation when the accident occurred. An official communication from the engineers to the Clyde Lighthouses now enables us to state that the talking beacon was in operation throughout the long spell of fog which occurred on that day, and that since its establishment in January last, it has given every possible satisfaction, both in its operation and to the vessels using it. The "Montclare," like many other vessels, relied, as hitherto, on navigating by means of the air fog signal on Cumbrae, and the others in the Firth of Clyde. The stranding has proved the inadequacy for safe navigation of the present system of coastal and port fog signals, however powerful, and, as anticipated, establishes the value of the talking beacon in giving simple and precise information to the seaman as to his distance and direction from the signal.

Railway and Road Matters.

A RAILWAY workshop is being laid out at Matsuyama, Taiwan, at a cost of about £300,000. The buildings will cover an area of some 350,000 square feet.

WORK is being expedited on the train ferry across the Yangtze River at Nanking, so that it will be ready for service in March of next year. Complete trains will then be able to run right through from Tientsin to Shanghai.

THE new locomotive running superintendent, for Scotland, of the London and North-Eastern Railway, in place of Mr. S. Groom, removed to Liverpool-street to succeed Mr. W. G. P. Maclure in the southern area, is Mr. G. A. Musgrave, the works manager at Cowlais.

THE adjourned coroner's inquest into the deaths of the three passengers and three servants who lost their lives in the Leighton Buzzard disaster of March 22nd was resumed on April 15th, and after hearing considerable evidence—but nothing of note that was not mentioned in our report of April 3rd of Colonel Mount's inquiry—was adjourned until to-day, Friday.

THE last six coaches of the 7.15 a.m. express from King's Cross to Leeds were derailed when approaching Tuxford Station, just south of Retford, on Friday, April 17th, of which one, a restaurant car, was turned on its side. The personal injuries were remarkably small. The cause has not yet been made known, but it is, perhaps, significant that permanent way renewals were in hand at the site.

THE historical Red Hall at Bourne is a fine old Tudor mansion, where the Roman Catholic rebellion in the Midlands was organised at the time of the Gunpowder Plot by Sir Everard Digby. It remained in the Digby family until 1860, when it was bought by the Great Northern Railway to form the station when the Bourne and Essendine branch was constructed. It has now been leased to some local interests for restoration and use as a museum.

THE position of traffic superintendent on the Metropolitan Railway, vacant by the sudden death of Mr. W. Holt, has been filled by Mr. G. Hally combining those duties with his present office of mechanical engineer and works manager. When Mr. C. Jones retired in 1924 from the position of chief electrical and locomotive engineer a division was made and Mr. Hally was given the mechanical engineering and Mr. R. P. Boulton brought in and appointed chief electrical engineer.

THE Great Western Company's special for the Grand National on March 27th, drawn by "Tregenna Castle," with a load of 349 tons, had a bad start owing to fog and passed High Wycombe 10 minutes late. It then covered the 138 miles between Denham and Shrewsbury in 135 min. 42 secs., and reached Birkenhead 7 minutes before booked time. Of twenty speed timings taken there were only two below 60 m.p.h.—one of 57·3 and one of 57·6; nine of between 70 and 80 m.p.h., and three of 82·5, 85·7 and 86·5 respectively. The "Tregenna Castle" worked throughout, but the enginemen were changed at Shrewsbury.

A SERIOUS situation for those road transport interests who run long-distance motor car services has been created by the opposition lodged by the railway companies affected to licences being granted to the road concerns for these services by the Area Traffic Commissioners. This opposition has been general, but one typical illustration will suffice to show the railway attitude. The road service in question is between London and Leicester, and the London, Midland and Scottish and the London and North-Eastern railways oppose the issue of the necessary licences on the ground that they already provide adequate passenger transport services at reasonable fares between those points and between the places along or near to the route to be served by the proposed services.

COMPLAINT was recently made in the House of Commons that there is overcrowding of trains during rush hours on the Underground Railway serving Kennington, Elephant and Castle and the City. Mr. Morrison stated, in reply, that he had been in communication with the City and South London Railway Company in the matter. They informed him that in the last three years the service mentioned had been increased during the hours of heavy traffic from 321 to 376 cars, an increase of 16 per cent. Improvements had also been made in the signalling on the line, enabling trains to be operated at the rate of 40 per hour during the peak periods. Experiments are now in hand on rolling stock design with a view to ascertaining whether it is practicable to adopt cars of increased length.

FOR the Football Association Cup Final at the Wembley Stadium to-morrow, the two railways most concerned—the Metropolitan and the London and North-Eastern—will run an intensive train service from Baker-street and Marylebone respectively, which will provide trains to arrive at Wembley at 50 seconds intervals and deal with 1000 passengers per minute. The former company has the advantage of four running lines into Wembley and four main platforms and some bay lines; it is, however, handicapped by the bottle neck of two lines between Baker-street and Finchley-road. The L. and N.E.R. has only two lines, but these are automatically signalled for a very frequent service, and the station at Wembley is on a circular loop and so continuity of movement is secured.

THERE has been a good deal in the papers recently as to officers of the two main routes to the North looking into the question of dividing the area in Scotland into West Coast and East Coast. We do not, however, see that much can be done in that direction, as it is certain that the London, Midland and Scottish Company will not relinquish its hold on Edinburgh, Dundee, Aberdeen, &c., nor the London and North-Eastern, on its side, surrender Glasgow. The only source of economy that seems possible to us is the withdrawal of the expresses between London and Edinburgh *viâ* Carlisle and the Waverley route, as the only important places that would then be inconvenienced would be Galashiels and Hawick. Whilst these remarks refer mainly to the passenger services, they apply equally to the goods traffic.

Notes and Memoranda.

IN an article in *Engineers and Engineering*, Mr. H. S. Simpson, of the American Electric Railway Association, discusses the economics of allowing motor cars to be parked in public streets. He estimates that the practice costs the community 5·76 dollars per car per day, or about ten times the cost of parking in a modern garage.

IN a paper read before the Institute of Fuels on April 15th Mr Arnold Marsh said that without attempting to bring into consideration the two important factors of the waste of potential wealth through the inefficient combustion of raw coal, and the considerable purely economic results of the lowering of the health standard, it was estimated that the cost of smoke to the nation was in the region of £80,000,000 a year.

IN connection with the Portuguese naval operations at Madeira, it is noteworthy that that navy possesses one of the oldest ironclads afloat. She is the armoured cruiser "Vasco de Gama," which is proceeding to the Azores. She was built on the Thames in 1876, but has frequently been "modernised," and is still the most powerful ship under the Portuguese flag. She displaces 3000 tons, has a nominal speed of 15½ knots, and is armed with one 8in., one 6in., and seven smaller guns.

PROJECTION of light from a bulb only about five or six times larger than the ordinary lamp used in the home, so that a person 5 miles away is able to read a newspaper by its rays, has been demonstrated at Cleveland, Ohio, by W. A. Pennow, an air port and airway lighting engineer with the Westinghouse Electric and Manufacturing Company. The light was projected from a searchlight throwing a narrow beam over Lake Erie. The beam over its course spread only 12ft. a mile. The searchlight is designed principally to aid aviators in determining the height of cloud banks. The narrow beam makes the determination more accurate than with previous methods. The searchlight contained a 420-watt lamp.

IN the course of a paper read before the Society of Chemical Industry, Mr. F. L. Bassett, Government Chemist, Iraq, described some experiments made on the corrosion of steel buried in alkaline soils. He said that the most severe corrosion was experienced with soils containing the equivalent of 0·01 to 0·2 per cent. of sodium chloride, and that the least corrosion was produced by the most highly saline soils. He explained this fact as being due to the water retentivity of salty soils, which checked the diffusion of atmospheric oxygen. He said that as this phenomenon was contrary to generally accepted principles, the observations were to be extended to investigations in the field.

IT is announced by the Secretary for Mines that official safety tests are to be made on electrical apparatus intended for use in mines where, although the normal conditions are considered sufficiently safe to permit the use of electricity, it is, nevertheless, necessary to take precautions against an explosion of fire-damp. The object of these tests is, briefly, to determine by actual explosion experiments whether the electrical apparatus under test is "flame-proof." By arrangement with the Safety in Mines Research Board, and with the help of their staff, a new Testing Station for this work has been erected and equipped by the Mines Department at Harpur Hill, Buxton, adjoining the Board's Research Station there; and the new station will be ready for work very soon. All inquiries and all applications for tests should be addressed to the Under-Secretary for Mines, Mines Department, Dean Stanley-street, Westminster.

AT a meeting of the general committee of the Plymouth Mercantile Association on March 31st, Mr. A. J. Osborne said he considered it beyond the bounds of possibility for a man to work as efficiently and rapidly while smoking as he would if he were not smoking. He, therefore, moved that the following resolution should be sent to the conference of the National Chamber of Trade:—"That this Association is of opinion that smoking in working hours is unnecessary, indefensible, and a distinct disadvantage to trade and industry. Moreover, as such smoking restricts output and increases the cost of production, employers and employed are invited, in the interests of trade efficiency, to discontinue the practice." Mr. Osborne had the support of several members, one of whom contended that considerable time was wasted by employees in filling their pipes and lighting matches, and that this was reflected in the cost of production. Other traders were of the opinion, however, that in some occupations, at least, smoking was a distinct advantage, and, after a number of views had been expressed, the resolution was put to the meeting and defeated by a large majority.

IN the hope of reducing the number of forest fires caused by sparks from railway locomotives, officers of the Forest Service of the United States Department of Agriculture are giving close attention to the evolution of improved types of spark arresters. Although progress has been made the number of "railway fires" is still large, an average of over 10,000 such fires a year having been reported in recent years on forest lands in the United States. Wire netting spark arresters on locomotives of several railway companies and on stationary engines in forest areas have helped to decrease the number of live sparks ejected from the smoke stacks. This type of arrester, however, has by no means eliminated the fire risk, since it has been found that many sparks get through the mesh. Recently, a certain railway equipped 300 engines in a mountain district with a new centrifugal type of spark arrester. It is reported that this railway's fire loss claims in the district decreased from 20,000 dollars to 180 dollars. Forest Service officers and railway officials recently tested different types of spark arresters on night trips over the Continental Divide in Montana. Wire-netting arresters, the observers found, did not prevent showers of sparks escaping from the locomotives on starting or on heavy inclines. Live sparks were caught several car lengths back from the engine, and sometimes landed on the ground as much as 75ft. from the rails. Another type of arrester which rotated the sparks through a drum to break them up and cool them before they were discharged from the chimney was found more effective. No cinders more than one-twentieth of an inch in diameter escaped from this arrester.

Miscellanea.

IT is reported that a motor omnibus driven by a heavy-oil engine, which is plying in Belgium, will run 18 miles to the gallon of fuel.

A GROUP of Chinese capitalists is planning the establishment of a heavy chemical works. About £50,000 is to be expended on the venture.

IT is proposed to expend about £100,000 on a water-works scheme for Wuchang, in the centre of China. Its capacity will be 4,500,000 gallons a day.

IT is claimed that a deposit of pitchblende which has been discovered on the shore of Great Bear Lake, North-West Territories of Canada, is the richest in radium of the world.

TRAFFIC through the Dardanelles increased by 40 per cent. during last year. The largest share in the traffic was held by Italy, with 4,551,000 tons. England came next with 3,699,000 tons.

A CANAL, 2½ kiloms. long by 15½ m. wide and 2½ m. in depth, is being constructed in connection with the improvement of the Port of Naples. The total cost of the work is estimated at 50 million lire.

THE new 10,000,000 cubic feet gasholder, which is being erected at Montreal, will probably be completed by October. It will be connected with the gas-making plant at Lasalle by a high-pressure main, 30 miles long, equipped with booster stations.

THE United States Navy has ordered eight more boilers with electrically welded drums for the new 10,000-ton cruisers. These are in addition to the twenty-four ordered last autumn. The drums are about 48in. in diameter and are designed to work at a pressure of 300 lb. per square inch.

FOR the purpose of facilitating the construction of the new circular arterial road round London from Harrow-road to Hanger Hill, the Grand Union Canal is to be carried over the road by a new aqueduct. This aqueduct is to be constructed in two separate halves, so as not completely to interfere with the canal traffic.

THE Minister of Health and the Minister of Agriculture and Fisheries have appointed a Committee to consider the present organisation for the prevention of damage by floods in the tidal portion of the Thames, and to make recommendations as to the further measures, if any, that may be necessary, as to the authority or authorities to which the duty of carrying out any such measures should be entrusted, and as to the basis on which the cost should be distributed.

THE report of the United Steel Works at Düsseldorf for the second quarter of the financial year 1930–31, running from January until March this year, shows a further decline of production and sale in all branches. In comparison with the preceding quarter the output of coal has receded from 5,230,000 tons to 4,690,000 tons; that of coke from 1,730,000 tons to 1,450,000 tons; that of pig iron from 948,000 tons to 808,000 tons; and of raw steel from 1,010,000 tons to 957,000 tons.

IT is learnt from Moscow that Professor Bergius has arrived there as the guest of the Union of Russian Chemical Industries. Last year Professor Bergius concluded an agreement with the Russians whereby the Chemical Union obtained the right to produce sugar from wood by the Bergius process. The agreement also provides for technical assistance by Professor Bergius and his colleagues in the construction of an experimental factory which is to be erected at Jaroslavl in the Volga district.

IT is proposed to utilise the natural gas, which is now being wasted in the Turner Valley oilfield of Alberta, for the generation power. An initial installation of 70,000 horse-power is to be put down and the completed scheme is estimated to cost 100,000,000 dollars. The gas will be piped 30 miles to the power-house, where its inherent pressure will be utilised in turbines. It will then be burned under boilers for raising steam. The price of power is to be 0·3 per cent. per kilowatt-hour, and it is to be distributed over a radius of 300 miles.

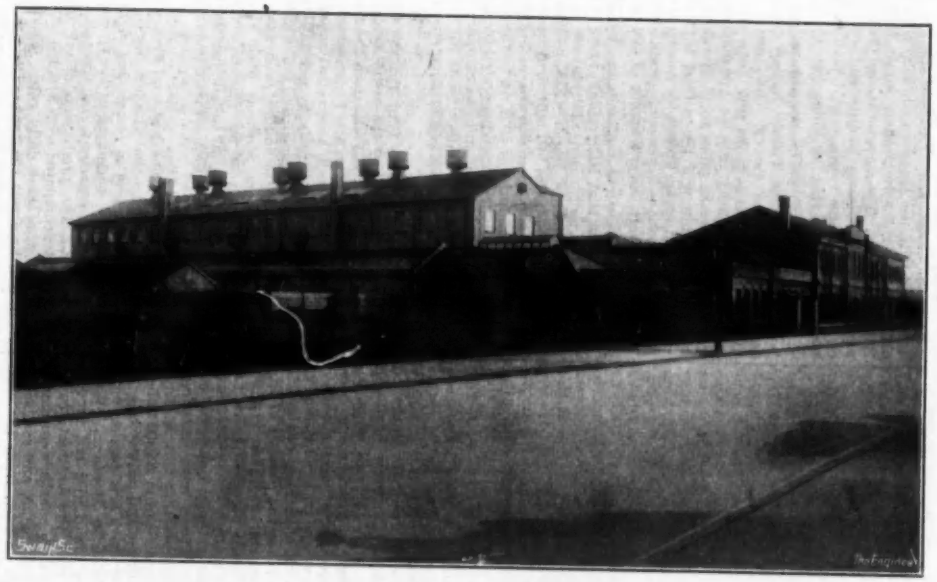
THE official returns rendered to the Electricity Commissioners show that 1038 million units of electricity were generated by authorised undertakers in Great Britain during the month of March, 1931, as compared with the finally revised figure of 967 million units in the corresponding month of 1930, or an increase of 7·3 per cent. During the first three months of 1931 up to the end of March, the total amount of electricity generated by authorised undertakers was 3185 million units, as compared with the finally revised figure of 3031 million units for the corresponding period of 1930, representing an increase of just over 5 per cent.

ON its return to this country, the Mission, which is being sent to Canada by the Federation of British Industries, will report to the Federation the results of its visit. If, as is possible, and as the Federation hopes may be so, the results of the Mission's conversations call for subsequent visits to be paid to Canada by delegations representative of individual trades or groups of industries, the Federation will do its utmost to induce such trades or groups to despatch delegations with as little delay as possible. The primary object of the Mission's visit is to initiate general conversations on broad lines in the hopes that, arising out of these, individual conversations on specific lines may follow.

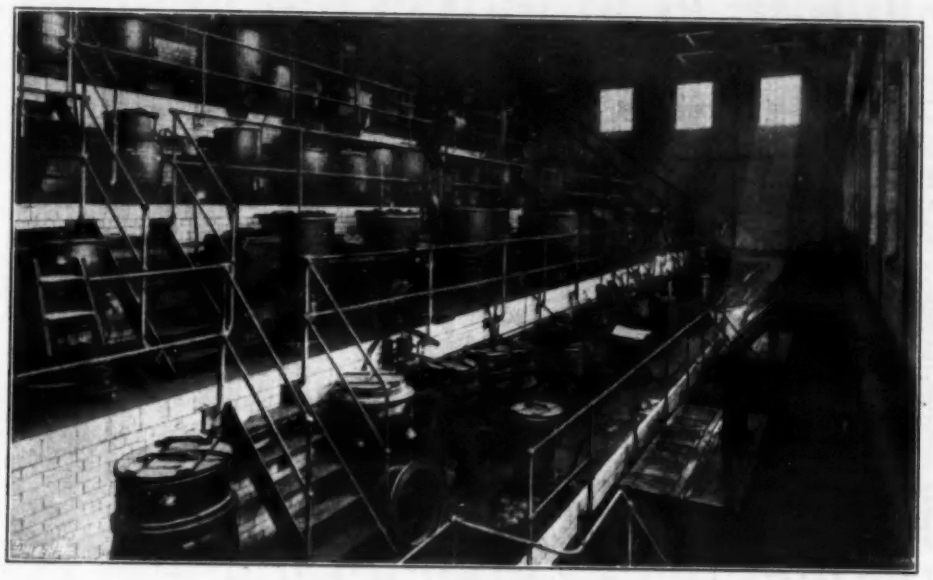
IT is reported by the National Federation of Iron and Steel Manufacturers that the number of blast furnaces in operation at the end of March was eighty-one, the same number as at the beginning of the month, three furnaces having ceased operations and the same number having commenced. The production of pig iron amounted to 357,100 tons, compared with 318,200 tons in February, or practically the same daily rate. Production in March, 1930, had been 665,800 tons. The production in March, 1931, included 95,600 tons of hematite, 131,200 tons of basic, 100,800 tons of foundry, and 16,100 tons of forge pig iron. The March output of steel ingots and castings amounted to 500,100 tons, compared with 486,400 tons in February, and 826,100 tons in March, 1930.

THE ACTON PRECIOUS METALS REFINERY OF THE MOND NICKEL COMPANY

(For description see page 454)



GENERAL VIEW OF THE REFINERY



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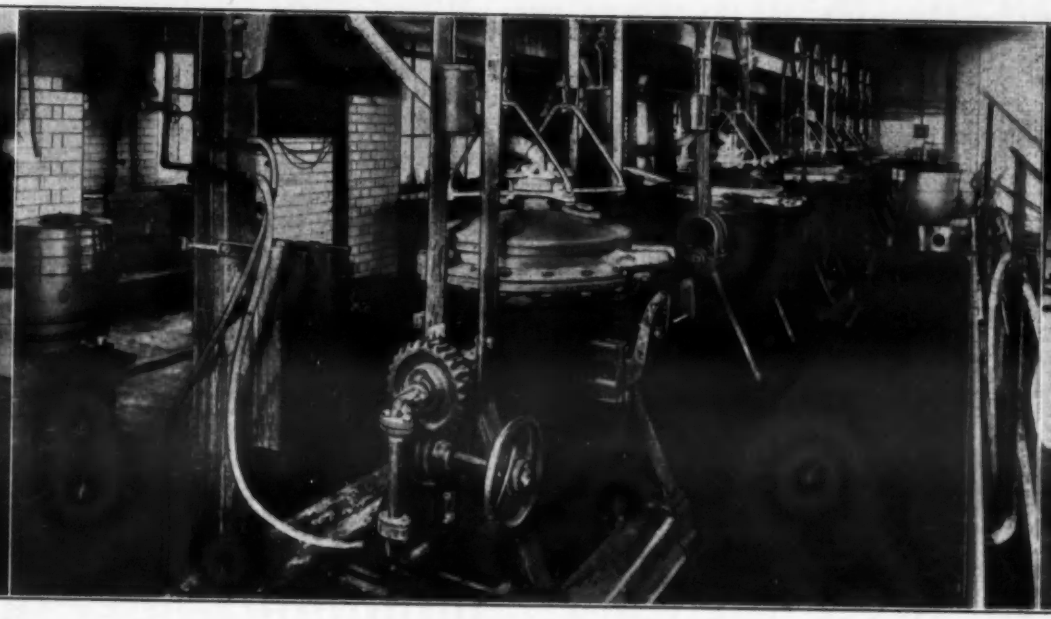

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The Metallurgist.

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THE ENGINEER.

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Education for the Engineering Industry.

ON October 31st, 1928, Lord Eustace Percy, then President of the Board of Education, appointed a Committee "to advise the Board of Education as to the scope and methods of the Board's inquiry into technical education for the engineering industry, and to review the material furnished to the Board in the course of the investigation." The Committee was a large one, composed entirely of manufacturing engineers with the exception of the Chairman, Sir Dugald Clerk, several other consulting engineers, Mr. J. T. Brownlie, then president of the Amalgamated Engineering Union; Mr. W. Sherwood, chairman of the Federation of Engineering and Shipbuilding Trades, and several professors. The Report was presented to Sir Charles Trevelyan, then President of the Board of Education, on July 17th, 1930, but was only issued to the public last Monday. In view of the thoroughness with which the Committee conducted its investigation we are not surprised that the preparation of the Report occupied over twenty months; but we find it difficult to understand why more than another nine months should have elapsed before publication. Fortunately, the delay makes no difference at all. Education for the engineering industry has gone on just the same during the thirty months, and, as far as the present Report is likely to make any difference, it will probably continue on the same road till another President of the Board of Education appoints another Committee. Take it for all in all, that is a satisfactory state of affairs. It shows that, in the opinion of a really representative body of engineers and educationalists, there is nothing radically wrong with the present methods; nothing that calls for any changes in the system, other than those that take place by natural growth. "Developments and, perhaps, certain modifications are desirable," says the Report, "but in our opinion they do not involve any serious reconstruction of that system."

The work of the Committee is presented under two main headings; first, the recruitment, and secondly, the education and training of the recruits. After careful consideration of the views expressed by hundreds of employers, the conclusion is reached that the engineering industry could beneficially absorb a larger number of youths who have continued their full-time education beyond the statutory school-leaving age. But inquiry showed that there is a tendency for secondary school boys and their parents to prefer "black-coated" occupations and to choose the office rather than the workshop. That is an extremely interesting and illuminating fact. It may, we suggest, be regarded as axiomatic that every lad who takes his education seriously looks forward to the time when it will elevate him from labour of the hands to labour of the head. That inclination has, in all probability, always existed, but with the reduction of the number of genuine handicrafts in factories we may expect it to grow. The Committee thinks that the tendency can be counteracted by strengthening the contact between industry and the schools, "and if it can be shown that prospects and conditions of employment are attractive." We are less confident than the Committee. It seems to us more likely that the tendency will augment rather than diminish, except amongst those lads who have an original bent towards engineering. Fortunately, they are just the lads that it is most desirable to obtain as recruits, and we commend the stress which the Committee lays upon the Junior Technical Schools, "whose continued existence in any scheme of educational re-organisation should be secured." Unfortunately, the Junior Technical School has at present a rather lower status than the Secondary School, and ambitious boys and their parents prefer the latter, much as the quarter-deck is preferred to the engine-room. The obvious course is to improve the position of the Junior Technical Schools and to make them the chief centre for the recruitment of youths for the engineering industry. The Report goes into a great many details which cannot conveniently be considered here, but, as we have already said, its general conclusion is that the existing system calls for little modification.

On one important question, however, we are left in the dark. The Report deals, as we have hinted, at considerable length with recruitment, but we have found in it no clear indication that the present supply of recruits is insufficient to meet the demand. We are informed "that methods of recruitment are often unsystematic," but no evidence to show that employers are dissatisfied either with the quantity or the quality of the recruits is presented. If positive testimony on that essential question had been forthcoming, we should have been in a better position to estimate the real value to industry of the long work of the Committee. We are led by what the Association of Technical Institutions calls the "very mild" character of the Report to conclude that no change is called for by the engineering industry as a whole, but we, nevertheless, regret that no attempt was made to estimate the capacity of the engineering industry for the absorption of recruits and to formulate the standard of education that it demands. In nothing is it easier to be extravagant than in specialised education. If industry does not require a larger proportion of youths with technical education than it can now obtain, then any change is undesirable. On general principles, it may be said, that a broad education will do more to create a happy community than a specialised one. It is better to enlarge the mind of youth by a liberal education than to give it an elementary scientific and technical education, of which it can never make adequate use. The evidence of the War showed that most workshop operations can be learnt by any intelligent person in a few weeks. Is it worth while spending much money and time on the specialised education of youths if they are never likely to rise above the position of machine minders? We know the difficulties of that problem, but upon the answer to it depends the economy with which education is conducted. It is by no means easy to choose between the alternatives of fitting a youth for a vocation and fitting him for citizenship. But we suggest that unless increase of efficiency by specialised training can be demonstrated then, in a large proportion of cases—but not by

any means in all—the greater weight should be allowed to the latter. A good workman can nearly always be made out of a good citizen, but a good citizen cannot be made out of a workman whose general education has been restricted.

Large Transformers.

With the help of designers connected with various electrical firms we have been able to keep our readers pretty well in touch with recent transformer developments. When it was proposed to interconnect power stations it became evident that a demand would arise for large transformers capable of voltage regulation on load or, alternatively, main and booster transformers or possibly induction regulators. Accordingly, in 1926 we collected information on all promising apparatus made in this country and published it in the form of a series of articles. But at that time British manufacturers had not begun to construct on-load tap changing gear; at any rate, nothing relating to that gear reached us, and the articles were therefore largely confined to descriptions of induction regulators and booster transformers for use with new or existing transformers. Attention was, nevertheless, drawn to the progress made in the development of on-load tap changing gear in America, and in the third article of the series, which appeared on April 30th, 1926, we gave the views expressed in a paper read before the American Institute of Electrical Engineers by Mr. H. C. Albrecht, who showed that transformers equipped with on-load tap changing mechanism offered considerable advantages. Since that time all manufacturers of large transformers in this country have developed tap changing equipments, which, with one or two exceptions, have been described in our columns. The manner in which British electrical manufacturers have grappled with this problem of regulating the voltage of large transformers, whilst carrying load, is worthy of the highest praise. Within the course of a few years they have built many large regulating transformers which are giving satisfaction.

For some time past it has seemed desirable that someone intimately connected with the business should read a paper on large transformer progress before the Institution of Electrical Engineers, and it was a matter of gratification to find that on Thursday, April 16th, Mr. R. M. Charley, of the English Electric Company, was to deal with this important and interesting subject. Although on the same occasion another paper was read by Mr. W. E. M. Ayres on "The Application of the Induction Voltage Regulator," and the discussion was intended to cover both papers, as a matter of fact it was almost entirely devoted to transformers. If Mr. Charley's paper had been confined to progress it would probably have given rise to little criticism, but being a transformer designer of long experience and having definite views on certain matters, the author did not hesitate to express opinions. Those who studied the paper before it was read and who are familiar with what is going on in different transformer shops, must have been able to make a pretty shrewd guess at the names of some of the members who would take part in the discussion and to form a fairly good idea of their line of argument. It was pretty obvious, for instance, that Mr. E. T. Norris, the chief transformer designer to Ferranti, Ltd., would contest the statement that the parallel winding method of on-load tap changing is almost obsolete, and that Mr. H. S. Holbrook, the chief of the B.T.H. transformer department, would disagree with the argument that while the non-resonating design of transformer is sound in theory, there is no justification for departing from present-day practice. As regards tap changing, it is perhaps not generally known that whilst Ferranti, Ltd., adopts both the parallel winding method and the tapped mid-point auto-transformer scheme, all other British firms use the latter exclusively. All the Ferranti "grid" transformers, we believe, are regulated on the parallel winding principle, whilst in transformers for other purposes both methods are employed. Generally speaking, however, operating engineers do not greatly mind how the voltage regulation is obtained as long as the equipment for that purpose is satisfactory and not unduly costly. Under the Central Board's contracts manufacturers have been given a free hand, and there were no restrictions regarding the methods of obtaining the regulation, other than the requirement that no phase displacement should be produced. Nevertheless, there is no doubt that in these days the great majority of manufacturers favour the external reactance or choke coil method which, we note, has recently been adopted by the Oerlikon Company. One of the most interesting facts which Mr. Charley brings to light in the section of his paper on tap changing is that recently regulating transformers combining the dual function of voltage and phase angle control have been built in order to control the flow of power in a ring main including two or more transforming stations, thus meeting an important requirement of the electricity supply industry. The non-resonating transformer, to which we have alluded, is another interesting piece of apparatus, which was developed in America and is now being made by the B.T.H. Company. Oscillations in the new transformer are limited by the use of electrostatic shields, and the ability of the transformer to withstand transient voltages is claimed to be greatly increased. The transformer was fully described in the *General Electric Review* of October of last year by Messrs. W. A. McMorris and J. H. Hagenguth, who attach much importance to the new idea. But, according to Mr. Charley—and we are sure that all manufacturers who are not building non-resonating transformers will agree with him—there is no justification for departing from present-day practice and using a system that is more costly. It is to be remembered, however, that operating conditions vary in different areas. Most electrical engineers appear to agree that the most troublesome surges are those due to lightning, which seems to be a source of continual worry to American engineers. In this country, however, lightning is not expected to be a serious matter, and drastic protective measures may not be so essential as they are elsewhere. On the other hand, British electrical firms must be in a position to cope with all operating conditions, and no scheme that offers security must be rejected without proper investigation. The Ferranti surge absorber is, of course, also claimed to overcome surge troubles.

On the whole, the discussion was quite instructive and indicated that, old as the transformer is, it continues to demand close study. No paper read before the Institution of Electrical Engineers this session has served a more useful purpose than Mr. Charley's, for while it only deals with the subject in a general way, it clearly indicates the lines on which the large transformer business has been developing, and gives a lead to other experts who are in a position to write separate papers on individual branches of the subject. It is a little difficult to see in what directions transformer manufacturers can improve upon existing designs. The efficiency of large units is now so high that no appreciable increase can be expected. Similarly in the matter of reliability, a high standard has been reached. Perhaps the most profitable field of investigation in the future will be that of looking into the question of what can be done to simplify some of the on-load tap changing equipments. It is a great pity that such a straightforward piece of apparatus as the transformer has had to be complicated by the addition of mechanical gear for changing tappings whilst the windings are carrying load, and every effort should be made to simplify and cheapen this gear without detriment to the all-important matter of reliable operation.

The Weir Report on Railway Electrification.

(From a Correspondent.)

An important committee was set up by the Ministry of Transport in September, 1929. In addition to Lord Weir and Sir W. McLintock, the well-known accountant, it included Sir R. Wedgwood, general manager of the L.N.E. Railway. The terms of reference were: "In view of the progress which is being made towards widespread availability of high-tension electrical energy, to examine into the economic and other aspects of the electrification of the railway systems in Great Britain, with particular reference to main line working, and to report their conclusions."

The Lord Privy Seal, in the House of Commons on April 16th, referring to this report, stated that it dealt with the complete electrification of the British railways at a cost of £261 millions, and that the yield would be 7 per cent.

The following figures indicate the position of the British railways in 1929:—

Issued capital	£1,134,770,000
Number of shareholdings	801,000
Number of employees	646,000
Route mileage	20,300
Track mileage, including sidings	52,500
Coal consumption, tons	13,413,000
Steam locomotives	23,400

The financial position of the railways to-day is shown by the following figures:—

	1913.	1930. Approx.
Gross receipts	£129,868,716	£184,900,000
Net receipts	46,113,893	37,300,000

This unfortunate position is due to three main causes, and has arisen in spite of all the benefits hoped for from amalgamation, from the cutting down of expenses in all directions, from an enterprising policy of advertising and from the reduction of fares and the improvement of facilities. The causes are: (1) The trade depression; (2) road competition; (3) a wages bill still nearly twice as large as before the War.

In view of this serious state of affairs it is necessary for the railways to examine all possible means of still further reducing working expenses, and, if possible, of increasing passenger traffic.

While suburban electrification appears to be an acknowledged success, main line electrification in this country has still to be proved. No main line scheme of magnitude would pay unless further suburban schemes were also carried out. The report, therefore, considers the electrification of all the lines in the country, though it is obvious that there are some hundreds of branch and unimportant lines which it would never pay to electrify. The use of Diesel electric units might be considered for these services.

Existing Electrifications.

Although the Newport-Shildon line of 18 miles on the L.N.E. Railway is the only instance of main line working in this country, there is a mileage of suburban electrification, amounting to 487 miles in all, while some 70 miles are in hand. Electrification has been carried further in other lands. There are 1013 miles of electrified lines in Italy, 1048 in France, 544 in South America, 726 in Sweden, 1542 in Switzerland, and 1870 in the United States.

In Switzerland nearly 70 per cent. of the total mileage and nearly 90 per cent. of the traffic is now electrically worked. The results for 1929 show a saving of £200,000 after paying interest and sinking fund. A similar result has been obtained in Sweden. The best proof as to the advantages obtained is the fact that in most of these countries electrification is proceeding. For instance, the Pennsylvania Railroad is converting 2700 track miles between New York and Philadelphia and Washington.

It must be said, however, that the conditions which led to electrification in most of these cases do not apply in Great Britain. The desire to use water power instead of importing coal, and the presence of severe gradients, are not important factors in this country, but it is pointed out that since the establishment of the "grid," electric power is available in England from coal-fired stations at prices little higher than where water power is available. In fact, the Central Electricity Board, it is believed, will quote a figure of about ¼d. per unit for power delivered at the D.C. bus-bars of the sub-stations for the use of the railways. But there is a more important factor than the cost of power, and that is the density of traffic, which, on the average, is far higher in this country than abroad. In fact, the density of traffic on many of our main lines is comparable with that to be found on suburban lines in other countries.

Electrification Possibilities in Great Britain.

The British railway companies have long been aware of the progress made elsewhere and the special reasons which led to it, and the results obtained from it; but, apart from financial questions, any decision was held up for several years by the discussion as to the best system. The D.C. *versus* single-phase controversy lasted for years and was not settled until the Pringle Committee's Report of 1928, which decided the question so far as this country was concerned. Before that the War had put a stop to all schemes, and after the War the numerous problems resulting from amalgamation prevented the Railway Boards from giving attention to new developments of this kind. The heavy capital cost of erecting new power stations was a further obstacle. The establishment of the Central Electricity Board and the laying down of the grid created a new situation. Instead of erecting their own stations, the railway companies are now, or will shortly be, able to obtain a supply of power at convenient points on their systems at a price little, if any, above that of water power. An equally important advantage is that they will be relieved of the burden of finding a large amount of the capital otherwise required.

Other Factors.

The cost of power is, however, by no means the only important factor in railway electrification. For instance, in Natal, where coal costs only 9s. a ton, electrification is justified, but so it is in Argentina where fuel costs three or four times as much. The saving effected by using electric power instead of coal in the locomotive will only be of the order of 10 per cent. The real saving will be found to be in wages and repairs. The reduction in wages arises not only, or even mainly, from the abolition of the fireman, as it will probably be necessary to keep two men on most of the important main line trains, but from the speeding up of traffic, the less lying-over necessary, and the longer daily mileage per locomotive. The abolition of the cleaning out of fires, &c., at the end of the journey is another factor. An equally important one is the reduction of repairs. The greater simplicity of the electric locomotive and the fact that it has no

fire-box or boiler or reciprocating parts means that a main overhaul is a much less costly matter than with the steam locomotive, and takes less time. It is estimated that the saving in repairs will probably amount to nearly one-third of the total savings.

INDIRECT ADVANTAGES.

Apart from the two main savings in wages and repairs, the electric locomotive, owing to the rotary motion of its parts, has been found under some circumstances to reduce wear and tear of track and to lessen the need for renewal or strengthening of bridges. From the traffic point of view, it has the advantage that it can operate for, if needed, twenty-two hours a day, can turn round and proceed with little more than a wipe-over after a long run, and is unaffected by weather or poor coal, as far as its speed is concerned. Its great powers of acceleration enable time to be made up with ease and a higher average speed to be maintained, especially where there are frequent stops. At the termini it can reverse without a turntable, and saves the time taken in coaling and watering. It provides a more comfortable cab for the crew.

DISADVANTAGES OF ELECTRIFICATION.

In addition to the heavy capital outlay involved in electrification, there are, of course, certain other drawbacks which must obviously be carefully considered before such a vast change in our railway system is contemplated. The question of reliability is important. While the failure of a steam engine stops one and delays possibly several more trains, the failure of electric supply on an important section might shut down scores of trains. Such a failure might be brought about by malice. Against this it may be said that alternative routes of cables, combined with protective devices, have reduced the failures of supply to a minimum, as is shown by the experience of almost unbroken continuity of supply over months and even years in most large towns and districts. Moreover, it will be remembered that in the General Strike it was not found that any serious stoppages could be brought about in electric supply.

If the third-rail system be adopted there is the risk of shock to be considered; in fact, in yards, the third rail is impracticable on this account. If the overhead system be adopted the risk of shock practically disappears, but the time and cost of repairs and maintenance is somewhat increased. In cases of railway accidents there is not much to choose, the risk of fire from short circuit being, probably, no greater than from live coals or other causes. Minor disadvantages, which Sir John Pringle's Committee considered could be minimised by proper precautions, are electrolytic action on neighbouring pipes and inductive interference with telephone and telegraph lines. Considerable troubles, it is understood, were experienced in Sweden and elsewhere in early days, but most of them, it is believed, have now been obviated by suitable rearrangement of circuits.

The reduction in the national consumption of coal is not a factor which directly affects the railways, but it must not be overlooked. On the other hand, the additional work provided for engineering works and for cable laying and sub-station building during the period, estimated at twenty years, that it would take to complete the work would mean, it is estimated, the employment of at least 60,000 additional men. So far as the dislocation of work in locomotive building is concerned, it may be assumed that much of the construction of the locomotives would be done in the same shops as hitherto, and in any case the transition would be a gradual one.

ALTERNATIVES TO ELECTRIFICATION.

Before such an important change in methods of haulage is undertaken, it is essential to consider fully all possible alternatives. Of these, the most promising would appear to be the oil-electric engine. It has a high fuel economy, and the adoption of electrical transmission of the power to the wheels gets over its inferior speed-torque characteristic. The complete machine is, however, rather heavy and without those special advantages in the way of overload capacity which enable the electric locomotive to give such a big acceleration and consequently high average speed. The oil-electric unit has been used both on the Buenos Aires and Canadian railways, but sufficient experience of the repairs and maintenance costs over a lengthy period is not available to enable a just comparison to be made with electric locomotives.

GENERAL CONSIDERATIONS.

The broader aspects of the expenditure of great sums on electrification must also be considered. Generally speaking, the likelihood of plant becoming obsolete depends upon the efficiency it has already attained. The comparatively low thermal efficiency of the coal-fired electric power station leaves much scope for improvement. The obsolescence of the power station plant will not affect the railways if they purchase their power. The very high efficiency of the electric motor and the electric cable leaves little scope for improvement in this direction—as is shown by the fact that they have undergone essentially little change in the last twenty years. The development of an entirely new storage battery is scientifically possible, but is not on the horizon. No battery to-day is practically capable of handling our main line traffic. While road haulage may increase, it seems probable that railways will for many years—owing to their enormous advantages in possessing their own tracks—remain the principal transport agency of the country. Their chief competitors—the roads—have had 500 millions of pounds spent on them in the last ten years, and are costing over 50 millions a year to-day. In view of this—even if the complete conversion of the British railways were carried out—costing £261 millions over twenty years, the annual expenditure of £13 millions would not appear excessive if their electrification proved to be otherwise desirable.

Literature.

The Manufacture of Artificial Silk (Rayon). By E. WHEELER, M.B.E., A.C.G.I., F.I.C., with a foreword by Sir WILLIAM J. POPE, K.B.E., D.Sc., LL.D., F.R.S. Second and revised edition. London: Chapman and Hall, Ltd. 1931. Price 12s. 6d. net.

THIS is the first of a series of applied chemistry monographs issued under the general editorship of E. Howard Tripp, Ph.D., who contributes a preface. The author calls attention to the fact that he uses the term "artificial silk" throughout the book, although the Silk Association has adopted the word "Rayon" in common with the usage of other countries, and the general adoption of the term to emphasise the definite distinction of rayon from silk. Having dealt very briefly with the history of rayon, the author proceeds to touch upon the chemistry of manufacture of each of the four processes. A point of striking interest is the change that has taken place in the positions occupied by fibres thus produced in the world's rayon trade:—

	1909.	1924.	1929.
Rayon production, metric tons	7,500	64,000	184,000
		Percentages.	
Nitro-cellulose process	48	7·8	3·3
Cuprammonium process	36	1·4	4·0
Viscose process	16	88·0	86·8
Cellulose acetate process	—	2·8	5·9

The viscose process being by far the most important of the four, it is not surprising that the most attention is paid to it. For rayons generally only cotton is used as the source of cellulose, but in the viscose process sulphite wood pulp is also extensively employed, being about 40 per cent. of the price of cotton waste or linters. The reason for the extensive use of the more expensive material is that the fibre made from cotton cellulose has 25 per cent. greater tensile strength than that made from wood. The economic need to recover some at least of the large quantities of caustic soda used in the process have led to the introduction of practicable methods of osmosis; the construction of such apparatus presents interesting chemical and engineering problems.

Although the production of rayon is essentially a chemical process, it is one in which success depends entirely upon mechanical efficiency; the spinning machines alone, capable of attaining 12,000 r.p.m., spinning 60 m. of thread per minute, consisting of maybe fifty-six filaments twisted together, are marvels of engineering construction and ingenuity. Even the drilling of the holes in the spinnerets with a diameter of 0·05 mm., accurate to ± 0·002 mm., presents its difficulties. A special feature of the description of the manufacturing processes of viscose, many details of which apply also to the other types of rayon, is the inclusion of reproductions of a number of excellent photographs of modern factory practice, the human touch lifting them much above the reproductions of machines from the makers' blocks. The flow sheets, too, are very valuable.

It is not surprising that nitro-cellulose rayon is dying out; it has little, if any, advantage over viscose rayon, and is more expensive; whilst cuprammonium rayon is softer, less glossy and stronger than viscose rayon. The proportion of the total production of the latter is still small, but it is increasing; its ultimate success would appear to rest with the possibility of recovering the used copper and ammonia. The manufacture of cellulose acetate rayon may be said to be still in its infancy, but the quantity is increasing year by year. There is an interesting chapter on some of the processes which have been brought forward from time to time, but which have not as yet made any commercial progress. The production of filaments from methyl or ethyl compounds of cellulose is a process upon which great hopes have been set, but so far as large-scale output has gone little has so far been accomplished.

Considerable space is devoted to a discussion of the properties of rayon. The lustre of the threads has presented noteworthy difficulties because of its excessive brightness; recent years have seen much research into means of reducing this to more pleasing proportions. Softness and covering power are other properties that have been modified. It is, however, in its lack of tensile strength as compared with silk that rayon is inferior, and the efforts of practically all the research departments are directed towards effecting improvements in this property. In order to increase the durability of rayon the process of roughening the treated threads with talc or cement is mentioned. It would be interesting to know what "cement" is in this connection. The chapter on dyeing is adequate, as there have been no recent developments.

The figures given on the uses of rayon might well have been brought up to date; one would imagine that it might have been possible to get more recent data than those for 1925 for England, 1928 for America, and 1926 for Germany. The past year or so has seen a period of quiescence as regards the introduction of fresh uses and of different types of fibres; manufacturers have apparently been concentrating on the improvement and cheapening of ordinary kinds. The increase in output of rayon during the past year forms a striking commentary on its position in the textile industry; the figures for the last four years are:—1926, 99,500 metric tons; 1927, 121,300; 1928, 158,000; 1929, 184,100. A comparison of the production of fibres generally is also interesting:—

	1923. m.t.	1928. m.t.
Cotton	5,227,000	5,000,000
Jute	1,590,000	2,000,000
Wool	1,364,000	1,500,000
Rayon	47,500	158,000
Silk	33,600	47,000
Ramie	1,130	1,130

A glance at these figures shows that rayon is having no injurious effect upon the silk trade, but may be affecting the consumption of cotton. The fact that the ramie production has remained exactly the same during the quinquennial period is noteworthy. The chief producing countries of rayon fall in the following order:—America, Italy, England, Germany, and France; the third and fourth having reversed their positions since 1926. Apart from the question of viscose, England produces the largest amount of cellulose acetate, America of nitro-cellulose, and Germany of cuprammonium rayon. In the last two years silk and wool have fallen 50 per cent. in price, cotton is two-thirds its former price, but rayon has maintained its old figure.

In an appendix there is a useful table showing tests for the identification of the various kinds of rayon. The work is well printed and there is a good index; allusion has already been made to the excellence of the numerous illustrations, which enhance the value of a book that is of great technical importance and is, moreover, very easy to read.

SHORT NOTICES.

The Gates of Light: A Record of Progress in the Engineering of Colour and Light. By Beatrice Irwin, A.A., E.A.W. London: Rider and Co. 1931. Price 7s. 6d.—We have to admit to our shame and regret that we do not know Beatrice Irwin, but the present book from her pen gives us the impression that she is an American and a student of the ingenious advertising methods cultivated by her countrymen. For, to be quite frank, this volume is really little more than a veiled advertisement for the Irwin Colour-Filter, which is an illuminated column of translucent material tinted in various colours and employed for the illumination of "homes," exhibitions and interiors in general. Around this "filter" the authoress has built a "story," just as Calisthenes might do, except that it is ever so much longer. There is a great deal in it about lighting and illumination, most of it appealing rather than scientific, but all leading eventually to the necessity of employing an expert when you have any lighting to do and of making sure that you do not miss the Irwin Colour-Filter.

Hydraulics for Engineers. By Robert W. Angus, B.A.Sc. London: Pitman. 12s. 6d.—In spite of the fact that very many books have been written on hydraulics, the subject is so wide that there must always be room for another. The present work is intended for the use of students and practical engineers. In his preface, the author says: "It is a matter of regret to most instructors of engineering students that the latter do not take more kindly to advanced mathematics, as the student's outlook is decidedly limited through lack of it." In whatever light we look upon this rather professional statement, it cannot be denied that the author himself has done his best to meet "the student's outlook," limited though it may be. The book is notable among students' reference books for the small amount of mathematics included. The author has divided his subject under three heads. The first part is devoted to the flow of water in pipes, orifices, weirs and open channels; the second deals at somewhat greater length than is usual in this type of book with hydraulic turbines and centrifugal pumps, while the last part, in which non-uniform flow is discussed, contains a final chapter devoted to hydraulic models. Exercises are given at the end of each chapter.

BOOKS RECEIVED.

England's Crisis. By André Siegfried. London: Jonathan Cape, 30, Bedford-square, W.C. 1. Price 10s. 6d. net.

The Design of Merchant Ships and Cost Estimating. Third edition. Alexander Kari. London: Crosby Lockwood and Son, Stationers' Hall-court, E.C. 4. Price 36s. net.

Flugmotoren in Leicht-und Schweröllbauart. By Dr. Haeder and Dipl.-Ing. W. Thoelz. Berlin: R. C. Schmidt and Co., Lutherstrasse 14, W. 62, Germany. Price 22·50 marks.

The Use of Home-grown Larch Poles for Transmission Lines: Forest Products Research Bulletin No. 8. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 2s. net.

Resistance of Ships and Models: Being New Methods for Estimating the Effective Horse-Power of Ships' Hulls. By N. W. Akimoff. Rome: Libreria di Scienze e Lettre, Piazza Mackima 19–20, Italy.

Post-War Land Turbine Development.*

By C. D. GIBB, B. Eng., Member.

Introduction.—When the war broke out the electrical power industry was on the eve of great developments. The manufacturers of turbine machinery, on whom the industry relies so largely for its progress and even for its existence, were preparing to supply it with generating plant far in advance of anything that had gone before. Indeed, the development had already begun. It may be said to have commenced in 1912 with the construction, at Newcastle-on-Tyne, of a notable unit of 25,000 kW. This machine, which passed all previous records for size and efficiency, probably represented the high-water mark of turbine construction prior to the war. The set, it may be remarked, is still in service, having earned for itself the affectionate title of "Old Reliability" from the operators of the Fiske-street Station, at Chicago, where it was installed.

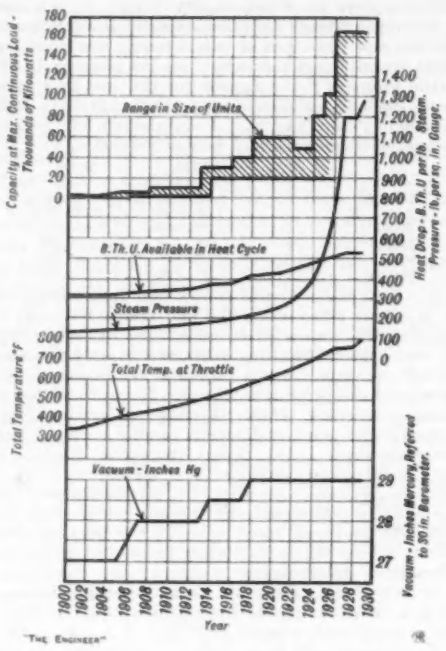

Capacity at Max. Continuous Load - Thousands of Kilowatts
Range in Size of Units
B.Th.U. Available in Heat Cycle
Steam Pressure
Total Temp. at Throttle
Vacuum - Inches Hg
Total Temperature °F
Host Drop - B.Th.U per lb. Steam.
Pressure - lb. per sq. in. Gauge.
Vacuum - Inches Mercury, Referred to 30 in. Barometer.
Year
"The Engineer"

FIG. 1—PROGRESS IN OPERATING CONDITIONS

During the years that the war was in progress there was little or no opportunity for the turbine maker to realise the possibilities he saw before him. All his energies had to be devoted to work of more pressing necessity. Power stations and ships still had to be equipped with turbine machinery, but the needs of the moment called for plant of standardised and proved design which could be turned out quickly. As a consequence, new development received a check, though two important steps forward during the war years have to be recorded.

First came the raising of total steam temperature and pressure when the Carville "B" station was put into service in 1917; the machines at this station represented a very large increase in output compared with previous practice at 2400 r.p.m. Later, came the North Tees "A" station with turbines working at a pressure of 450 lb. per square inch, and the serious adoption of the resuperheating cycle which had been provided for in Carville "B" but was not put into service. Such great advances on previous practice were due to the engineering courage of Messrs. Merz and McLellan and the Newcastle-upon-Tyne Electric Supply Company, and though they gave rise to difficult problems at the time, the experience gained formed a basis for the very rapid post-war developments which form the subject of the present paper.

How enormous the progress has been is indicated graphically by Fig. 1, which shows the advance in operating conditions made by one of the leading American turbine makers, the Westinghouse Electric and Manufacturing Company, through whose courtesy the author is enabled to show the diagram. During the period with which the paper deals it will be seen that the maximum size of units built by that company has increased from 60,000 kW to 160,000 kW, pressures have gone up from about 200 lb. to 1300 lb. per square inch, temperatures from 600 deg. to 800 deg. Fah., and available heat from about 400 to well over 500 B.Th.U. per pound. Other companies, to whom acknowledgment is made later, have also been kind enough to assist the author with information. He has, indeed, made every effort to secure representative data from continental and American turbine builders. No attempt has been made to secure similar information from British makers, as it was felt that the report in the "Proceedings" would have much greater value if the representative British manufacturers would themselves contribute details of their own developments in the discussion. The author also hopes that valuable contributions to the discussion will be made by operating engineers, who can do so much to help the designer by a free expression of opinion on defects.

Improvements in Efficiency.

(*a*) *Turbine Efficiency Ratio.*—The improvements in turbine internal efficiency as distinct from gains due to a greater temperature range are particularly noticeable when considering the smaller sizes of plant, and Fig. 2 shows the turbine efficiency ratio plotted against the plant size for the years 1913, 1919 and 1930. It will be seen that, although the efficiency ratio of a 25,000 kW turbine has increased by 4 per cent. since 1913, the improvement in a 3000 kW set has been nearly 13 per cent., and a modern 3000 kW turbine is only 5 per cent. less efficient in steam consumption than the present-day 25,000 kW machine. It should be noted, however, that a bigger difference would be found in comparing heat consumptions since the larger unit would permit the use of a more comprehensive feed-heating equipment.

Improved designs in nozzles and blading and the use of higher velocity ratios has been mainly responsible for this increase of efficiency, and the work done by the Steam Nozzles Research Committee of the Institution assisted impulse turbine designers in no small measure. Reaction turbine manufacturers have made an equal advance by their own extensive researches. The closest attention is now given to the elimination of eddies in the steam-flow and coned blading is almost universally adopted. Steam-chests and nozzle-boxes are carefully designed to secure the minimum pressure drop, while thick leaving edges to nozzles and blading are strictly avoided. The standard of workmanship in nozzles and blading is much improved, and the importance of smooth steam passages is fully appreciated.

It is instructive and interesting to note that the great majority of turbine designers are now adopting the principle laid down by the late Sir Charles Parsons as far back as 1884, namely, that to obtain the highest efficiency in a steam turbine the steam-jet velocities must be moderate. This is obtained by the adoption of a multi-stage design with a small pressure drop per stage.

Multi-cylinder turbines for large outputs are now almost

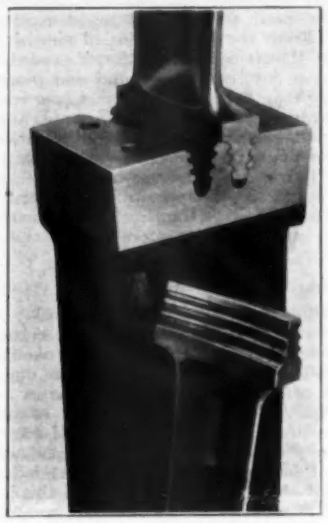


FIG. 6—BLADE-ROOT FASTENING

universal, and the tendency is towards a greater degree of reaction, especially in the low-pressure region.

(*b*) *Thermodynamic Cycle Efficiency.*—The increase of temperature range or available heat drop produced a more concrete gain in the form of less coal consumed per unit generated and is worthy of some study.

Table I. gives a list of machines both in this country and abroad, and from this table Figs. 3, 4 and 5 are plotted, showing the general range of initial pressure, heat drop available, and heat consumption per unit generated for representative Parsons machines. The figures given for heat consumption in the table for machines Nos. 27–63 must be regarded as approximate only, since in a large number of cases insufficient information is available and certain assumptions have had to be made.

The adoption of regenerative feed-heating is almost universal in present-day power plants, and this results in lower heat consumption, reduced erosion, and increased turbine output for a given exhaust annulus area, or, alternatively, a smaller condenser for a given output. The whole question of regenerative feed-heating has been very thoroughly discussed by Baumann and Guy in papers recently presented before the Institution.

The available heat drop may, of course, be increased by

(*a*) raising the steam pressure;
(*b*) raising steam temperature;
(*c*) reducing back pressure;
(*d*) interstage reheating after partial expansion.

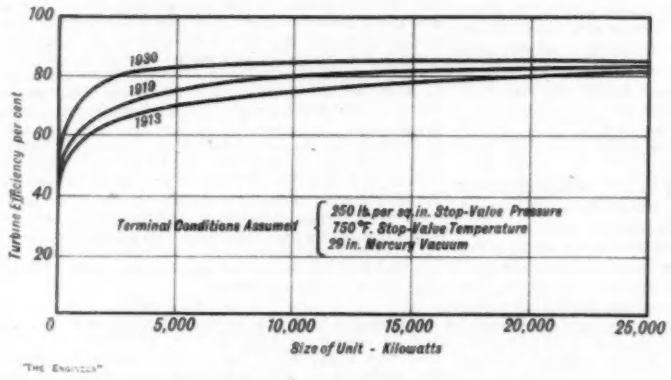


FIG. 2—TURBINE EFFICIENCY AND SIZE OF PLANT

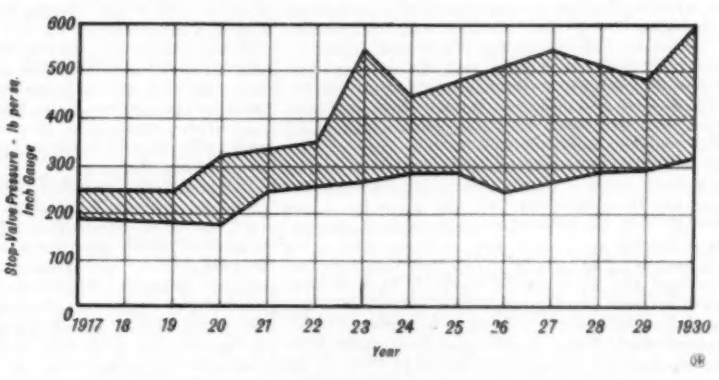


FIG. 3—RANGE OF INITIAL STEAM PRESSURE

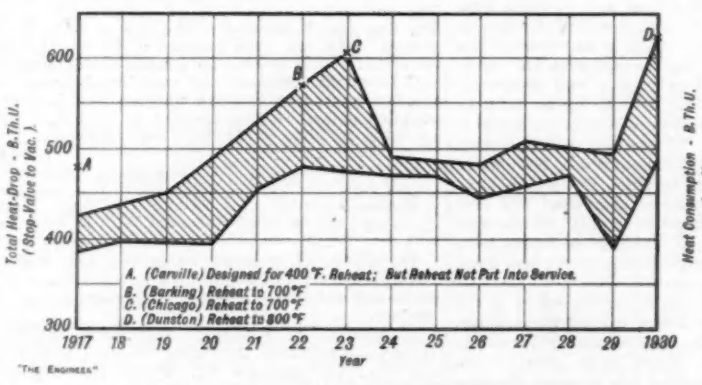

Total Heat-Drop - B.Th.U. (Stop-Valve to Vac.).
A. (Carville) Designed for 400 °F. Reheat; But Reheat Not Put Into Service.
B. (Barking) Reheat to 700 °F.
C. (Chicago) Reheat to 700 °F.
D. (Dunston) Reheat to 800 °F.
Year
"The Engineer"

FIG. 4—RANGE OF AVAILABLE HEAT DROP

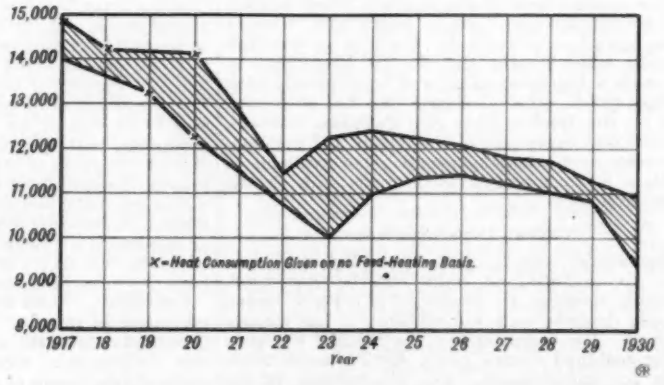


FIG. 5—HEAT CONSUMPTION PER UNIT GENERATED

* The Institution of Mechanical Engineers, April 17th, 1931.

POST-WAR LAND TURBINE DEVELOPMENT

TABLE I.—*Particulars of Representative Machines.*

No.	Year.	Station.	Output, maximum continuous rating.	Speed, r.p.m.	Type.	Stop valve pressure, lb. per sq. in. gauge.	Stop valve temperature, ° F.	Vacuum, inches mercury.	Heat drop, Stop valve Vac'm, B.Th.U.	Feed heating. ° F.	Heat consumption with feed heating, B.Th.U. per kWh.	Maker.	Remarks.
1	1917	Carville	10,000	2,400	Double-ended L.P. cyl. tandem	250	650	29·0	481	120	14,020	Parsons	Reheating to 400° F.
2	1917	Carville	10,000	2,400	Double-ended L.P. cyl. tandem	250	650	29·0	451	120	14,300	Parsons	—
3	1917	Bradford	15,000	1,500	Single cyl.	190	584	28·0	387	—	14,863*	Parsons	—
4	1918	Lots-road	18,000	2,000	Double-ended L.P. cyl. tandem	185	500	29·0	399	—	14,197*	Parsons	—
5	1919	Mersey Power Co.	12,500	3,000	Double-ended L.P. cyl. tandem	250	550	29·0	451	—	13,215*	Parsons	—
6	1920	Shanghai	20,000	1,500	Single cyl.	180	572	28·5	396	—	14,112*	Parsons	—
7	1920	Treforest	15,000	1,500	Single cyl.	325	725	29·1	489	—	12,196*	Parsons	22,500 kW momentary overload
8	1921	Victorian Rlys., Australia	15,000	3,000	Double-ended L.P. cyl. tandem	250	700	28·75	453	185	12,831	Parsons	—
9	1922	Barking	20,000	3,000	Double-ended L.P. cyl. tandem	350	700	29·0	480	250	11,400	Parsons	—
10	1922	Barking	40,000	3,000	Cross compound H.P. and L.P., I.P. and L.P.	350	700	29·0	568	250	10,750	Parsons	Reheating to 700° F.
11	1923	Dalmarnock	21,000	1,500	Single cyl.	270	700	29·1	474	150	12,240	Parsons	—
12	1923	Chicago	50,000	1,800 720	Cross compound 3 cyls.	550	750	29·25	604	315	10,026	Parsons	Reheating to 700° F.
13	1924	Derby Corp.	10,000	3,000	Single cyl.	290	700	29·0	472	180	12,370	Parsons	—
14	1924	N. Tees	25,000	2,400	Double-ended L.P. cyl. tandem	450	700	29·9	490	300	11,020	Parsons	—
15	1925	Brimsdown	25,000	3,000	Three-exhaust double-ended L.P. cyl. tandem	290	700	29·0	472	270	11,325	Parsons	—
16	1926	Congella	12,000	2,000	Single-cyl. duplex exhaust	250	700	28·5	445	190	12,048	Parsons	20,000 kW for 2 min.
17	1926	Barking	20,000	3,000	Double-ended L.P. cyl. tandem	350	700	29·0	480	280	11,080	Parsons	—
18	1926	Edmonton	10,000	3,600	Single cyl.	250	650	28·85	445	—	13,240*	Parsons	—
19	1927	Castner Kellner	6,000	6,000 3,600	Geared side by side	550	750	28·8	506	250	11,800	Parsons	—
20	1928	Derby Corp.	20,000	3,000	Single cyl. duplex exhaust	290	700	29·0	472	180	11,710	Parsons	—
21	1929	Regina	15,000	3,600	Single cyl. duplex exhaust	350	725	27·05	433	250	11,207	Parsons	—
22	1929	Velsen	30,000	1,500	Double-ended L.P. cyl. tandem	399	752	28·9	497	284	10,854	Parsons	—
23	1929	Calcutta	20,000	3,000	Single cyl.	195	590	28·0	389	170	13,300	Parsons	—
24	1930	Hackney	30,000	3,000	Double-ended L.P. cyl. tandem	350	750	28·7	481	280	10,920	Parsons	—
25	1930	Dunston	50,000	1,500	Single-ended L.P. cyl. tandem	600	800	29·0	618	340	9,280	Parsons	Reheating to 800° F.
26	1930	Copenhagen	36,000	1,500	Double-ended L.P. cyl. tandem	323	743	29·0	489	284	10,845	Parsons	—
27	1922	Barton	27,500	1,500	Single cyl. impulse	350	700	29·1	486	200	11,958	Metropolitan-Vickers	—
28	1924	Trenton Channel, Detroit	50,000	1,200	Single cyl. impulse	375	700	29·2	493	—	12,285*	General Electric	—
29	1924	Philo, Ohio Power Co.	40,000	1,800	Single cyl. impulse	560	725	29·0	590	314	10,360	General Electric	Reheating to 725° F.
30	1925	Buenos Ayres	50,000	1,500	2 cyl. tandem impulse	550	750	28·8	614	—	11,020*	General Electric	Reheating to 750° F.
31	1925	Twin Branch S. Bend., Indiana	40,000	1,800	Single cyl. impulse	550	725	29·0	584	385	10,250	General Electric	Reheating to 725° F.
32	1925	Columbia	45,000	1,800	2 cyl. tandem impulse	550	725	29·0	584	—	10,600*	General Electric	Reheating to 725° F.
33	1925	Boston Edison Illum. Co.	35,000	1,800		1,200	700	350lb. per sq. in. g.	—	—	—	General Electric	—
34	1925	Hudson Avenue, N.Y.	80,000	1,800	Cross compound H.P. and L.P. I.P. and L.P.	376	700	29·0	483	361	11,000	American Westinghouse	—
35	1926	Leghorn, Italy	14,000	3,000	Single cyl. radial flow	330	842	29·0	519	—	12,370*	Ljungstrom	—
36	1926	Crawford-avenue	77,000	1,800 1,200	2 cyls. cross compound impulse	550	750	29·0	515	—	11,790*	General Electric	—
37	1926	Klingenberg	80,000	1,500	Cross compound H.P. and I.P. impulse L.P. reaction	478	752	28·8	501	280	10,470	A.E.G.	—
38	1926	Utrecht	20,000	3,000	4 cyls. in line, 2 impulse, 2 react'n	455	752	28·65	492	176	12,243	Stork	—
39	1926	Milwaukee Lakeside	7,000	3,600	Single cyl. impulse	1,200	720	332 lb. per sq. in.	—	—	—	General Electric	—
40	1928	Stanton	47,000	1,800	Single cyl. impulse	600	725	29·0	610	320	10,259	General Electric	Reheating to 725° F.
41	1927	Barton	40,000	1,500	2 cyl. Raumann exhaust impulse	350	700	29·0	480	300	10,920	Metropolitan-Vickers	—
42	1927	Hams Hall	30,000	1,500	Single cyl. impulse	350	700	28·12	449	295	11,100	General Electric alternator, Fraser and Chalmers turb.	—
43	1927	Hudson-avenue, N.Y.	110,000	1,800	Cross compound H.P. and I.P. and 2 L.P.	400	700	29·0	486	270	10,620	American Westinghouse	—
44	1927	Waukegan Gen. Co.	50,000	1,800	2 cyl. tandem reaction	600	725	29·0	510	—	11,700*	Allis-Chalmers	—
45	1927	Witkowitz Coal Co.	19,500	3,000	4 cyl. tandem impulse	1,425	915	28·8	641	—	10,900*	Erste Brünner	Reheating to 662° F.
46	1927	Crawford-avenue	91,500	1,800	Cross compound 2 cyl. impulse	550	750	29·0	530	—	10,800*	General Electric	Reheating to 500° F.
47	1927	Powerton, Ill.	55,000	1,800	2 cyl. impulse	600	725	29·0	583	350	9,650	General Electric	Reheating to 725° F.
48	1928	Hell Gate	165,000	1,800	2 lines, 4 cyl. impulse reaction	266	700	29·0	467	252	11,300	American Westinghouse	—
49	1928	Mannheim	5,000	3,000	Single cyl. impulse	1,425	842	285lb. per sq. in. g.	180	—	—	Brown Boveri	—
50	1928	Hell Gate	160,000	1,800 1,200	Cross compound, 2 cyl., pure reaction, double-ended L.P.	265	610	29·0	442	208	11,500	Brown Boveri	—
51	1929	St. Denis, Paris	50,000	3,000	4 cylinders	710 850	842 900	29·07	586	—	11,200*	Oerlikon	—
52	1929	Issy-les-Moulineaux	11,200	1,500		483	797	29·0	523	338	10,820	Brown Boveri	—
53	1929	Liverpool	50,000	1,500	2 cylinders	400	800	29·0	516	300	10,600	Metropolitan-Vickers	—
54	1929	State Line, Ind.	208,000	1,800	3 cyl. cross compound, 1 H.P. 2 two-flow L.P.	600	730	29·0	539	380	10,250	General Electric	Reheating to 500° F.
55	1929	Delray, Detroit	10,000	3,600	2 cyl. tandem impulse	365	1,000	29·0	575	300	10,260	British Thomson-Houston	—
56	1929	East River, N.Y.	160,000	1,500	2 cyl. impulse	376	700	29·0	484	—	11,680*	General Electric	—
57	1930	State Line, Ind.	150,000	1,800	3 cyl. impulse	1,200	832	29·0	675	—	9,900*	General Electric	Reheating to 832° F.
58	1930	Pekin	105,000	1,800	3 cylinders	600	725	29·0	589	—	10,550*	General Electric	Reheating to 750° F.
59	1930	Waukegan	115,000	1,800	2 cylinders	625	750	29·0	598	—	10,600*	Allis-Chalmers	Reheating to 750° F.
60	1930	Battersea Corp.	30,000	1,000	2 cylinders	300	750	29·0	487	300	10,850	General Electric	—
61	1931	State Line	125,000	1,800	2 cylinders	1,200	825	29·0	672	—	9,900*	Allis-Chalmers	Reheating to 825° F.
62	1931	St. Denis, Paris	50,000	3,000	4 cylinders	770 to 980	842 to 880	29·07	582	360	10,300	Brown Boveri	—
63	1931	Schelle, Ant.	60,000	3,000	3 cylinders	500	797	28·88	519	330	10,680	Siemens-Schuckert	—
64†	—	Barking	75,000	1,500	3 cylinders	600	800	29	533	340	9,850	British Thomson-Houston	No reheating

* Based on no feed heating. † Figures supplied by Mr. Samuelson at the meeting on April 17th.

(*a*) Steam pressures have been increased fairly rapidly in the past few years, and in the absence of sufficient accurate data on the properties of steam at very high pressures, and until further operating experience has been obtained, it is not safe to predict the sort of pressures which will be in common use a few years hence. Pressures from, say, 400 lb. to 600 lb. per square inch, are now quite common, and it is probable that the next step above this pressure will be a large one, possibly to 1400 lb. or 1500 lb. per square inch.

(*b*) The problem associated with the use of total steam temperature exceeding 750 deg. Fah. has already been dealt with before the Institution,‡ and it is sufficient to say that turbine design for the present will probably stabilise itself at a maximum temperature of 850 deg. Fah. until metallurgists produce an alloy steel or other material at a price enabling the temperature to be economically raised.

The British Thomson-Houston Company have built for the Detroit Edison Company a 10,000 kW tandem two-cylinder machine to operate at an initial temperature of 1000 deg. Fah. with a stop-valve pressure of 365 lb. per square inch, and much valuable data will be obtained from this plant after prolonged operation. The same gain in thermal efficiency would have been realised had the initial pressure been raised from 365 lb. per square inch to about 1000 lb. per square inch, and the temperature limited to 750 deg. Fah., but difficulties due to wetness at the exhaust end would have been introduced.

Experiments carried out at Messrs. Parsons' Heaton Works with ordinary mild steel superheater tubes showed that these were quite unsuitable for a total steam temperature of 950 deg. Fah. at a pressure of 200 lb. per square inch, but it was realised that the independently fired superheater used was being forced to obtain that steam temperature and the outer surface of the tube probably reached a temperature of 1300 deg. Fah. or over. On the other hand, it was not overlooked that with steam at higher pressures, the increased density would enable a lower external tube temperature to be maintained.

(*c*) The decision as to whether the back pressure may be reduced in any particular case is purely one of economics.

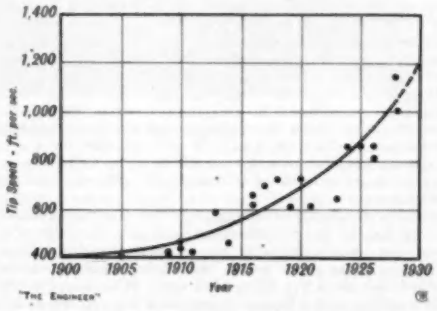


FIG. 7—MAXIMUM BLADE-TIP SPEED

When the reduction in steam consumption is balanced by the extra power required for pumping additional water through the condenser plus the increased cost of the larger exhaust necessary for handling the greater volume of steam it is obvious that a further increase of vacuum is not justified. Circumstances seldom justify a back pressure lower than 1in. of mercury absolute.

(*d*) The extension of the thermodynamic cycle made possible by the adoption of reheating may be large or otherwise, depending upon whether the reheating is carried out by flue gas or live steam. This is a subject on which great differences of opinion are held and a general survey of the position will be of interest.

Reheating by means of flue gases was adopted in the North Tees "A" station and in a modified form was later applied to a 40,000 kW set at the Barking Power Station of the County of London Electric Supply Company. The operating results here have shown that little or no difficulty is experienced in the general operation of the set, although it is obvious that owing to the time taken to reach steady conditions when starting up it is advisable that the set be run as a base-load machine and only stopped after long periods of running, for condenser cleaning, &c. So far as the turbine is concerned, the test results have shown that the anticipated reduction in heat consumption is obtained. Minor troubles were experienced when the set was first run with reheating, but these were no more serious than was to be expected. No difficulty is experienced in maintaining steady reheat temperatures, and it can safely be stated that the experience gained with this plant justifies the belief that the general adoption of very much higher steam pressures need not be retarded on account of any difficulties with interstage reheating which will then become necessary.

The practice of reheating by means of live steam has been advocated, and, in fact, tried in certain cases, but generally, where the initial steam pressure has been comparatively moderate. With a constant total temperature the higher the initial pressure the greater is the advantage derived from reheating, and where the steam pressures are relatively low the thermal gain due to reheating has rarely justified its adoption.

For initial steam conditions of 600 lb. per square inch,

‡ "Proceedings," I. Mech. E., 1927, vol. i.

800 deg. Fah. total temperature, reheating can be justified for large units, while for 1200 lb. per square inch initial pressure and the same temperature, reheating is easily justified thermodynamically and is practically a necessity from an erosion and final stage efficiency point of view.

Extended experience in the United States of America has given results so varied that it is difficult to draw any very definite conclusions as to the trend of opinion there. Several of the earlier reheating installations utilised flue gas reheating, while later live steam reheating was adopted, but at the present time it would seem that a return to flue gas reheating is being made.

It will be seen from Table I., machine No. 25, that reheating is being adopted on this plant, and this will be by flue gas, the reheater element being located in a combined reheat normal evaporation boiler. Flue gas reheating is essentially a boiler problem, since reheating does not add appreciably to the turbine design, although it may necessitate changing from two to three-cylinder machines for very large outputs.

The tendency during the past decade has been to raise both the steam pressure and temperature without the general adoption of interstage reheating. The back pressure has remained sensibly constant. The future development will probably be along the lines of a still further increase of the steam pressure without a larger increase in the steam temperature, but with the adoption of interstage reheatiag. This, of course, applies to the large units which are now commonly regarded as being the size of machine to be adopted for modern power generation.

Increase in Unit Size.

It has already been mentioned that a very economical 25,000 kW unit was operating in 1913, and this was a reaction two-cylinder tandem machine running at 750 r.p.m. In 1928, two-cylinder tandem units of the same output, but running at 3000 r.p.m., were in successful everyday operation, and a 38,000 kW—maximum continuous rating—tandem two-cylinder reaction turbine has recently been started in Hamburg. The Barking Power Station of the County of London Electric Supply Company has four 40,000 kW two-line, cross-compound machines at 3000 r.p.m. in successful operation, while several four-cylinder, single-line units of 50,000 kW at 3000 r.p.m. are under construction on the Continent, and sets up to 80,000 kW at this speed are contemplated.

Single-cylinder machines for high vacua with an output of 10,000 kW at 3000 r.p.m. were remarkable in 1921, but a single-cylinder turbine developing 20,000 kW with a vacuum of 28·8in. mercury and running at 3000 r.p.m., is now in service at the Derby Borough Electricity Works.

Blade tip speeds have increased from 700ft. per second to an average figure to-day of 1000ft. per second, and some machines are in operation having tip speeds of 1150ft. per second; for example, the 60,000-kW, 1800 r.p.m. impulse reaction turbines recently constructed by the Westinghouse Electric and Manufacturing Company, of South Philadelphia. The blades in the final row are 34in. long on a spindle diameter of 78in., and the so-called side-entry blade root fastening was adopted, as shown in Fig. 6. The disc carrying the blades was formed from a 3½ per cent. nickel steel forging. The same company have expressed the opinion that although a maximum tip speed of 1150ft. per second is their present limit, it does not appear improbable that longer blades will be used in the near future. Consideration has been given to the possibility of a 90,000-kW single-flow machine at 1800 r.p.m., equipped with blades 40in. long in the final row, with a tip speed of 1257ft. per second. Fig. 7 is a graph supplied by the Westinghouse Company showing the advance made in maximum tip speed during the period 1900–1930. Messrs. Brown Boveri also report the use of a maximum tip speed of 1140ft. per second.

Recently Dr. Melan, of the Siemens-Schuckert Werke, Berlin, stated that his company can build a single-cylinder turbine of 90,000 kW capacity at 1500 r.p.m., without exceeding the ordinary factors of safety, by the use of a specially constructed rotor in which the low-pressure discs have no central holes but are bolted together longitudinally. This construction is not new, having been proposed by Dr. Roeder in a patent specification dated 1915—British Patent No. 12,369. The use of a wheel without a central hole was first adopted by De Laval in 1896 for the larger units of his well-known simple impulse turbines.

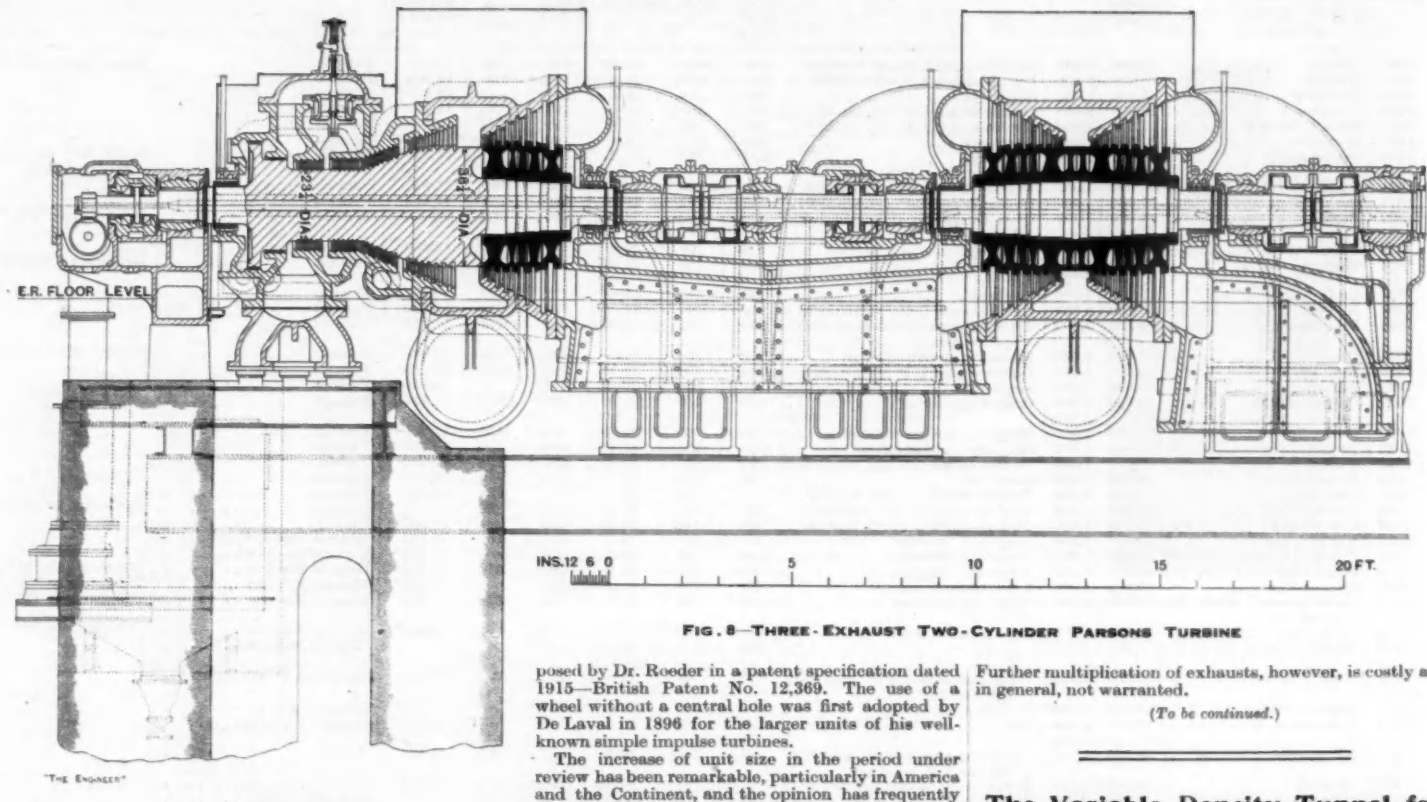


FIG. 8—THREE-EXHAUST TWO-CYLINDER PARSONS TURBINE

The increase of unit size in the period under review has been remarkable, particularly in America and the Continent, and the opinion has frequently been expressed that the desire to go one better than one's neighbour has occasionally dictated to engineering common sense. Whether this is so or not there is at least one case where a very large unit was installed, but the next two sets to be ordered were of much smaller capacity. Two things probably contributed to this reduction in size, not the least being that the first and larger machine was a cross compound multi-line set, while the later and smaller machines are to be single-line units. It is fairly obvious that if the size of a machine required does not exceed that which can be built as a single-line unit for the speed in question, then the single-line type will be preferable on the grounds of lower capital costs per kilowatt. A single-line unit for a given output is almost invariably cheaper to manufacture than a multi-line unit. This would seem to be a reasonable line of development to expect where very large systems are to be supplied with power, so that the tendency in America will probably be to build the largest single-line units for 1800 r.p.m., while in this country it is reasonable to assume that there will be an appreciable jump in size between a 3000 r.p.m. plant and 1500 r.p.m. machines.

Limiting Factors in Size Development.—In dealing with this question it is proposed to consider 3000 r.p.m. machines only, since 50-cycle supply is becoming standard on the Continent as well as in this country. In general the same limiting factors as apply to 1500 r.p.m. machines apply equally to those running at 3000 r.p.m.

Large turbine plants for land purposes are almost entirely used for driving alternators, and in one sense it may be said that present-day practice makes the alternator the first limit to turbine size for 3000 r.p.m. Turbines may have one, two, three, or four cylinders in line, but only a single alternator is economically justified, and thus the alternator limits the output, for few manufacturers are prepared to build alternators with an output exceeding 60,000 kW at 3000 r.p.m. The turbine design for outputs greater than this is quite simple if overall length is not strictly limited and four-cylinder machines can be accommodated. Tandem alternators are, however, by no means unknown, and thus the combination of a multi-cylinder turbine and tandem alternators could readily give an output of 120,000 kW at 3000 r.p.m. The practicability of such a design is unquestioned, but the advisability is a matter of opinion, and shorter machines with single alternators are almost universally adopted.

Output at a given rotational speed must, of course, always be considered in conjunction with the absolute back pressure, since the exhaust annulus area generally determines the output, and it is obvious that for a given maximum exhaust area the output must be reduced as the back pressure is reduced if reasonable efficiency is to be maintained.

Modern standards of efficiency in this country demand a leaving loss at most economical load not exceeding, say, 3 per cent., while financial considerations seldom allow it to be less than 1 per cent. American practice allows a leaving loss up to 5 or even 6 per cent. at economical load, thus enabling much bigger outputs for a given stress to be obtained, but at a lower efficiency. The area available for a single exhaust is largely limited by the blade tip speed to which the designer is prepared to go, and by using high-grade alloy steels for discs and blades, higher stresses can be safely used and blade tip speeds of 1200ft. per second should be quite safe. The maximum single exhaust annulus area known to the author for a 3000 r.p.m. machine is 22 square feet, and for an absolute back pressure equivalent to 1in. of mercury with a leaving loss of 2 per cent. this gives an output of 12,000 kW per exhaust, when no regenerative feed heating is adopted.

Tandem cylinder turbines with a double-flow low-pressure cylinder are very common, and form one method of obtaining increased output. Three-exhaust two-cylinder machines, such as shown in Fig. 8 offer another solution and make a 50,000-kW—maximum continuous rating—3000 r.p.m. machine of reasonable length fairly simple. Further multiplication of exhausts, however, is costly and, in general, not warranted.

(*To be continued.*)

The Variable Density Tunnel for the National Physical Laboratory.*

By A. J. GRANT, Wh.Ex., M.I.N.A.

(*Concluded from page 439.*)

All the drums having now been successfully rolled, it only remained to anneal them and transfer them to the machine shop. Our largest gateway in Carlisle-street—No. 12—had been specially enlarged for this purpose, but we were not free from trouble on this short journey, as the wheel of the traction engine sank into the ground, causing the bogey with the first drum on it to heel over, fortunately without touching the wall, but at a very unpleasant angle just opposite the time office. We managed to jack it up, and it was eventually safely landed under the crane in the machine shop. We had a large Richards vertical lathe which was big enough to tackle the job, and the drums were machined to shape, every drum taking about four weeks to do, working double shifts. As they were completed they were taken to the large armour erecting shop, and, concurrently, the heavy forged steel straps, which had been roughed out individually on the radial planing machine, were assembled into complete rings, and also finished on the vertical lathe, the recess being machined to a gauge made when two adjacent rings were put together. The large end castings were also machined and drilled, and the job began to take shape.

It will be realised that the fitting of the heavy forged straps could be much more easily accomplished with the axis of the drum vertical. The first two portions to be put together consisted of one of the end castings and one of the forged steel drums, and when the casting was superposed on the drum and the straps fitted, it was impossible to get a feeler into the joint between the two, a very satisfactory result, considering the magnitude of the surfaces involved. Each drum was fitted on to its neighbour in this manner, the casting having been removed from the first drum and this drum in turn fitted upon the next.

We had the cast steel cradles in place on the floor of the shop, and the first operation was to lift the drum into its cradle, which was safely accomplished. The turning over of these drums to a horizontal position required a considerable amount of care on the part of the crane driver and slinger.

It will be realised that a drum of this diameter when standing on the floor would sag with its own weight. A calculation was made which was borne out very closely, and it was found that the horizontal axis exceeded the veritcal axis by ⅛in. When, however, the drum was lifted into the cradle which had been machined to the correct radius and was so supported round about a third of its circumference, the difference in the two diameters disappeared, and the drum again became practically a true circle.

The problem, however was how to lift the next drum and get it into place, as had it been lifted by the top portion it would have assumed an oval form in the opposite direction; that is, that the vertical axis would have exceeded the horizontal one. Resort was had, therefore, to wire slings which took the pressure round rather more than half the circumference of the drum, and it was thought that the pressure of the wire would partially counteract the sagging due to the weight of the other portion. As a matter of fact, it did rather more than this, and the drum was again an oval with the vertical axis slightly longer than the horizontal one. The rest was easy.

* Paper read before the Junior Institution of Engineers.

All we had to do was to lower the drum on to a chock and take a certain amount of weight off the crane until the drum was a true circle and then jack it into place, the spigot going easily into the recess of the adjoining one. This method was adopted for the erection of the rest of the structure, and it all went together with extraordinarily little trouble, a tribute to the accuracy of the machining and the care of fitting the straps when the drums were in a horizontal position.

It will be seen that at one end the hemispherical end is pierced at the centre to allow the propeller shaft to pass through, and this aperture was blanked off on the inside for the purpose of testing. At the other end there was a large swing door 4ft. 6in. diameter, mounted with a vertical hinge having ball bearings and with clamps to

FIG. 7—TRANSPORT OF SECTION BY ROAD

tighten it up, the joint being made by a copper ring. This door was arranged to open inwards; the internal pressure, therefore, assisted in keeping the door tight, and no difficulty was experienced in this respect.

Everything was now ready to fill the drum with water for testing purposes. It was coupled up to the water main by means of 4in. pipes through a tee piece attached to the bottom of the centre drum and the water was admitted under the town pressure, the safety valve at the top being left open to allow the air to escape. Nearly 300 tons of water were required to fill the space, and it took 18 hours to accomplish.

The drum having been completely filled, pressure was applied by means of the pumps serving the armour press, which had had a special pipe connection made for this

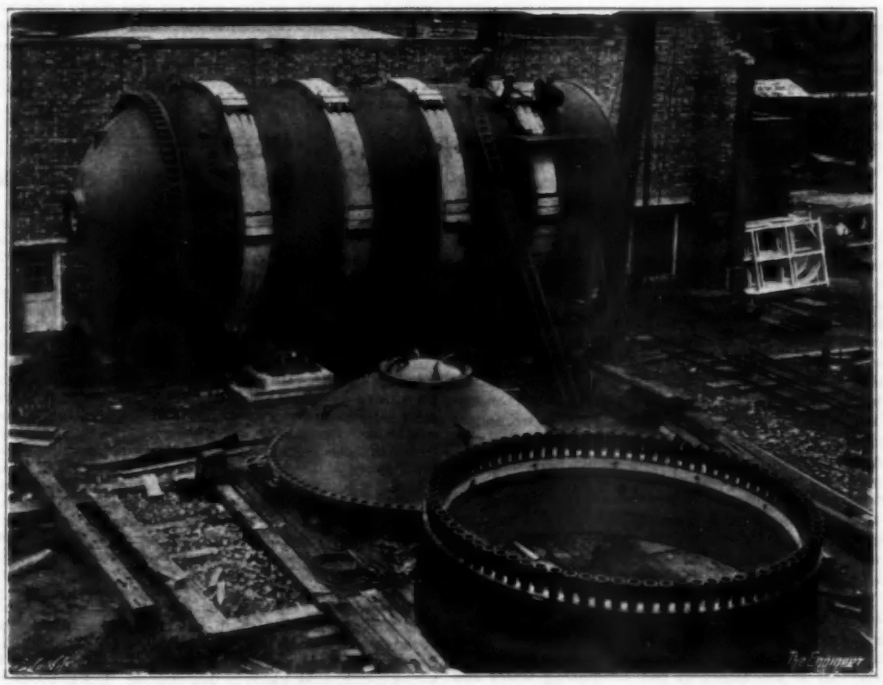


FIG. 8—THE TUNNEL BEING RE-ERECTED AT TEDDINGTON

purpose, and pressure was gradually applied. Micrometers had been fixed at each end and steel tapes round the drums so that accurate measurements could be taken of any alteration in form which took place under pressure. The first time pressure was raised we found a certain amount of leakage in the joints between the drums owing to the tremendous end pull which was exerted, and, as mentioned before, the full test pressure of 550 lb. to the square inch put a load of over 8000 tons on these joints.

The lead rings which had been caulked into the recess of the grooves were not able to accommodate themselves to the slight variation in form which took place, and we came to the conclusion that it would be necessary to ensure that the joints between the drums were tight, to regard them as expansion joints, and to adopt some means to follow up the infinitesimal separation which took place due to the end pull. We, therefore, emptied the tunnel, removed the lead rings and replaced them with leathers, the ends of which were joined by a scarf joint at the bottom, making a continuous ring. These rings were held in place by means of iron rods ground off so as to be flush with the inner surface of the drum, a necessity of the design, and pressure was again raised. The effect of the pressure was to force the U leathers into the V groove, and eventually, after they had accommodated themselves to the very slight inequalities of the surfaces, they became completely water-tight.

Representatives of His Majesty's Office of Works and the National Physical Laboratory came down to witness the preliminary water test, and were, the author thinks, fully satisfied with the result. It speaks well for the quality of the castings forming the ends that there were only one or two small blow-holes discovered, which were easily remedied by electric welding.

The alterations of form which took place under the full pressure were extremely interesting. The whole structure lengthened by ¼in., and the drums themselves grew in circumference at the portions midway between the joints by about ⅛in. The elastic extension lengthways of the whole structure was less than we had calculated theoretically, and we came to the conclusion that this was due to a sort of Poisson ratio effect owing to the structure increasing in diameter, as mentioned above, which partially counteracted the end expansion.

On the removal of the pressure all the micrometers went back to zero, showing that there had been no permanent set anywhere and that the structure was well within its elastic limit even at this high pressure which exceeded the working pressure by 55·5 per cent., so that we were well satisfied that the structure would be perfectly safe under working conditions.

The next problem to be tackled was how to get these very large pieces transported to their permanent site at Teddington. It had been obvious from the start that railway transport was out of the question, and various fantastic suggestions had been made of moving it to the Sheffield Canal, floating it out to sea and towing it round as a whole, although this suggestion was never actually put before the Board of the Sheffield and South Yorkshire Navigation Company owing to the shock which it might have given to their nervous systems. Instead, we got in touch with Messrs. Marstons, of Liverpool, the well-known firm of road contractors, who had a short time previously moved a rudder from Darlington to our Clydebank shipyard for the large Canadian Pacific liner, "Empress of Britain," particulars of which journey appeared in the Press at the time. This was a great achievement, which took three weeks to accomplish, and the author believes in one place, near Edinburgh, they had only 1in. to spare between buildings on each side of the street.

Messrs. Marstons did not anticipate any great difficulty in removing these drums for us, and in actual practice their confidence turned out to be fully justified. Most of the pieces took about forty-eight hours to get from Sheffield to Teddington, and met with a certain number of difficulties on the way. One of them, for instance, got into the middle of a push bicycle race somewhere near London—Fig. 7*—and it was referred to in the contemporary issue of *Cycling* in the following plaintive terms:—"This monster that progressed over the 'Oak 100' course during the race was not the figment of a distressed competitor's imaginings. It was, too, too real, and hindered traffic all along the route."

One drum, however did actually get from Sheffield to Teddington in eighteen hours, this rapid transit possibly being due to the fact that the driver of the lorry in question had only been married that afternoon and was called out for duty immediately after the ceremony, and naturally was very anxious to rejoin his bride, who was somewhere in the industrial regions of Lancashire. The first drum which left our works in the afternoon got on to the Great North Road, *viâ* Retford, and it successfully passed through this town in the early hours of the morning through a narrow street, which you all probably know, which is only 15ft. wide, so that it consequently overhung the pavement considerably on each side.

The second man, thinking he could follow the same route, unfortunately arrived in Retford during the middle of the day and was promptly turned back by the police and had to go round by another route. How he managed to turn round, history does not relate.

After this, most of the pieces went through Worksop and Ollerton and got on to the Great North Road at Newark. They proceeded down the Great North Road until they came to the North Circular By-pass, which skirts the north-western suburbs of London, arriving at Teddington without any great difficulty.

On arrival at Teddington, the lorries got as near to the site as possible, and the drums were slid on to chocks ready to receive them. Messrs. Markhams had erected a couple of strong derrick poles and had put down some powerful hand winches. The whole of the lifting and erection was accomplished without a single mishap, and as far as the author knows without a single mark having been made on the jointing portions of any of the drums or castings—a very notable achievement. Re-erection proceeded and made good progress, the first drum being placed in position on August 11th, and the last end casting being jointed up on November 25th—Fig. 8. During that period, in addition to erecting the main outer shell, the whole of the internal portion of the tunnel, consisting of very complicated castings and plate and angle work, was also erected and inserted into the tunnel, the end carrying the door being left open until this work had been accomplished—Fig. 9.

Everything came in extraordinarily well and very little

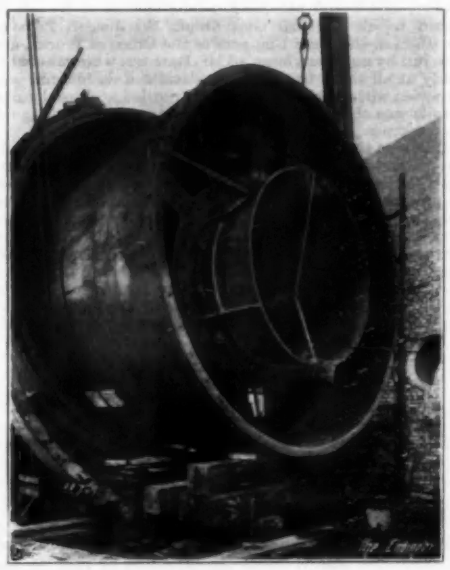


FIG. 9—END OF TUNNEL DURING RE-ERECTION

difficulty was experienced. The re-erection having been completed, the necessary pumping arrangements were installed again to fill the tunnel with water for the final test.

Pressure was gradually raised in the tunnel, and to start with there was a small amount of leakage at the joints, as the leathers, which, of course, had had to be removed during transit and re-erection, were getting caulked into place by the internal pressure. As the pressure rose, this leakage gradually stopped, and eventually at the full working pressure the whole structure was completely water-tight.

The preliminary test, with our own officials present, took place on Friday, December 5th, and as the weather was frosty and we had satisfied ourselves that everything was all right, we took steps to have the official test completed as soon as possible, owing to the possible risk of danger by frost to the pipes connected to the tunnel. The official test, therefore, was arranged for Monday, December 8th, and took place in the presence of Sir Joseph Petavel, K.B.E., F.R.S., the Director of the National Physical Laboratory; Mr. E. F. Relf, in charge of the Aerodynamics Department; Mr. A. G. Ramsey, of His Majesty's Office of Works, who was the engineer-in-charge of the contract; his assistant, Mr. A. B. Joscelyne; and various other Government officials. The test was completely successful, and the whole structure was there and then accepted by the Government as being satisfactory, and the author received the congratulations of the officials present on the completion of what had been a somewhat anxious and arduous contract.

An interesting experiment was carried out during the release of pressure from the water test. Measurements were taken as to the amount of water evacuated, and these were correlated with the pressure as shown by the gauge. This showed that the expansion of the tunnel was sufficient to increase the volume by 1 cubic foot for every 15 lb. rise in pressure, from zero up to the working pressure of 353 lb. per square inch and the graph indicates this as a straight line.

Nothing now remained except to empty the tunnel and proceed with the final adjustments necessary for the internal structure of the tunnel and the fitting of the propeller shaft, which, as I have mentioned previously, was to be connected to a 400 H.P. motor situated on a block of concrete near the end of the tunnel.

The propeller shaft is arranged to work in ball bearings and through a labyrinth stuffing-box made of carbon segments of the same type as is employed in marine turbine practice, which was designed for the purpose by our engineering department at Clydebank. The shaft itself is made of Nitralloy steel, so as to minimise any wear which may take place in the stuffing-box portion.

Messrs. Markhams were now able to remove all the

* Fig. 7 is reproduced by permission of *Cycling*.

lifting tackle, and the construction of the building which will house the tunnel is now being proceeded with, and it is expected that the air compressors will be ready in about three months' time.

In conclusion, the author would like to express his personal thanks to the members of the company's staff and workmen, who have all given of their best in the construction of this somewhat novel piece of apparatus, and, in particular, to mention Mr. Mascall, who personally supervised the rolling of the drums, Mr. D. G. Jones, our chief engineer, and the esteemed President of your Sheffield Section, Mr. Beaumont, the chief designer, who was responsible for all the calculations of stress, &c., and particularly to Mr. Stirling, who was in entire charge of the erection of the tunnel in the shops here and also during re-erection at Teddington. It is entirely due to the care and skill displayed by these gentlemen that we were able to achieve such a successful conclusion to our labours.

The author would also like to congratulate Mr. Macartney, Mr. Welby, and Messrs. Markham's staff generally on the successful and expeditious manner in which they carried out the re-erection of these heavy pieces on a site totally unprovided with any appliances.

Messrs. Marstons, the road contractors, also carried out their part of the contract in a most satisfactory manner, no trouble having arisen over what at one time looked to be a formidable difficulty, viz., the transport from Sheffield to Teddington.

The author has had many years of experience in dealing with Government Departments in the carrying out of various contracts, but can safely say that he has never met with more consideration and help from the official bodies than was received from those gentlemen in the Air Ministry, the National Physical Laboratory, and the Office of Works, and would like his personal thanks to be put on record to Sir Richard Glazebrook, Sir Joseph Petavel, Mr. Baines, the Chief Engineer of the Office of Works, and last, but by no means least, to Mr. Ramsey, who was always ready at all times to thrash out details of design and construction with us, and whose wide knowledge of mechanical details was of inestimable value to us in the completion of the contract.

In about three months' time, the tunnel should be ready for use and should be the means of providing this country with data as regards aeronautical design far ahead of that at present possessed by any other nation. It should be able to supply designers with reliable information as to the stresses to be expected in high-speed flying, and should still further ensure the safety and welfare of those gallant men who are prepared to risk their lives not only in ordinary commercial flying, but also in such contests as those for the Schneider Trophy or in the still grimmer hazards inseparable from aerial warfare.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

"IN THE HANDS OF THE BANK."

Sir,—A leading article in the issue of The Engineer of April 17th should direct the attention of your readers to a matter second to none in importance, not only to engineers, but to the world at large at the present time.

In view of this, it seems essential that a clear understanding should be established as to exactly what it is which banks lend to industry, the non-repayment of which places industrial concerns in the position described by the title of your leading article.

Probably, even now, the overwhelming majority of business men, including engineers, are under the impression, perhaps without having formulated the matter very clearly, that there is a fixed amount of money in the world, that a great deal of it is deposited for safe keeping with the banks, and that what the banks lend is this money which has been deposited with them. This is not, of course, the case.

The matter has been epitomised in a short sentence by Mr. McKenna, chairman of the Midland Bank: "Every loan creates a deposit, and the repayment of every loan destroys a deposit." The following explanation may make this clear to those who are not familiar with the technique, and who imagine that the money which banks loan to their customers is limited by the amount they receive from other customers. Imagine a new bank to be started—its so-called capital is immaterial. Ten depositors each deposit £100 in Treasury notes with this bank. Its liabilities to the public are now £1000. These ten depositors have business with each other and find it more convenient in many cases to write notes—cheques—to the banker, instructing him to adjust their several accounts in accordance with these business transactions, rather than to draw out cash and pay it over personally. After a little while the banker notes that only about 10 per cent. of his business is done in cash—in England it is only 0·7 of 1 per cent.—the rest being merely book-keeping. At this point depositor No. 10, who is a manufacturer, receives a large order for his product. Before he can deliver he realises that he will have to pay out in wages, salaries, and other expenses considerably more "money" than he has at command. In this difficulty he consults his banker, who, having in mind the situation just outlined, agrees to allow him to draw from his account not merely his own £100, but an "overdraft" of £100, making £200 in all, in consideration of repayment in, say, three months, of £102. This overdraft of £100 is a credit to the account of depositor No. 10, who can now draw £200.

The banker's liabilities to the public are now £1100, none of the original depositors have had their credits of £100 each reduced by the transaction, nor were they consulted in regard to it, and it is absolutely correct to say that £100 of new money has been created by a stroke of the banker's pen.

Depositor No. 10 having, happily, obtained his overdraft, pays it out to his employees in wages and salaries. These wages and salaries, together with the banker's interest, all go into costs. All costs go into the price the public pays for its goods, and, consequently, when depositor No. 10 repays his banker with £102 obtained from the public in exchange for his goods, and the banker, after placing £2, created by himself, to his profit and loss account, sets the £100 received against the phantom credit previously created, and cancels both of them, there are £100 worth more goods in the world which are immobilised—of which no one, not even the banker, except potentially, has the money equivalent. A short mathematical proof of this process is as follows:—

Let deposits .. =D.
Let loans, &c. .. =L.
Let cash in hand =C.
Let capital .. .. =K.

Then we have—

Assets .. .. .. =L+C.
Liabilities .. .. =D+K.
So that .. .. L+C=D+K.

Differentiating with respect to time, we have—

$$\frac{dL}{dt}+\frac{dC}{dt}=\frac{dD}{dt};\ \text{K being fixed, } \frac{dK}{dt}=0$$

Assuming that the cash in hand is kept constant $\frac{dC}{dt}=0$.

Therefore

$$\frac{dL}{dt}=\frac{dD}{dt}$$

which means, of course, that the rate of increase, or decrease, of loans, is equal to the rate of increase, or decrease, of deposits.

An understanding of this process must make it clear that, sooner or later, every business must come into the hands of the banks as at present operated, or, in other words, the amalgamation of industry and banking is inevitable if either is to survive. The vital question which requires urgent consideration is whether the banker is the right man to direct industry, or the engineer. The problem is very much of the same order as arriving at a decision as to whether the number of trains between London and Edinburgh shall be governed by the number of tickets in the booking office at Euston, or, alternatively, by the number of people who want to go to Edinburgh in relation to the rolling stock available to transport them.

London, April 21st. C. H. Douglas.

ELECTRIC HEATING.

Sir,—A Leader in your issue of April 10th might profitably be read in conjunction with the report of the meeting of the Institution of Civil Engineers on Tuesday last.

It appears from the figures given by the authors of the paper that one of the latest power stations running with the exceptional load factor of 50 per cent., can do no better than throw out 50 per cent. of the steam heat into the river, whereas in an industrial plant—as, for instance, a modern newsprint paper mill—the greater part of this heat would have been usefully employed in the process work.

Can any power station, whether feeding the "grid" or an independent network, supply current at a price which would tempt the paper mill owner to buy it? I think not.

If we really intend to have cheap electricity, central station engineers must turn their attention to the sale of heat as well as power. Bled steam, especially if superheated, could easily be distributed over a considerable area, as the reorganisation at Woolwich Arsenal has proved, but the power station should be in a factory area, such as Slough or Trafford Park, for choice, although the heating of office blocks in cities need not be neglected. Burton-on-Trent would be an ideal place to try out an experimental station, as the steam required by the breweries for wort boiling, cask washing, &c., would provide a fairly even loading of the station plant.

Shutting down a "peak" station on the "grid" in order to give a high load factor to the latest and most efficient station sounds attractive, but the capital charges on the "peak" stations run on, and if the "efficient" station continues to waste its coal in the condenser, I think, with Colonel Crompton, that the "grid" will increase, rather than lessen the cost of electricity.

Increasing the thermal efficiency by small increments, such as are obtained by the use of air heaters may be desirable, but if the losses in the circulating water are allowed to persist, it seems, as Mrs. Poyser would say, "saving at the spigot and letting out at the bung."

Leslie N. Burt.

London, W.C. 2, April 20th.

OIL *v.* COAL.

Sir,—It is with considerable surprise that one reads an announcement in your columns and in various sections of the Press to the effect that the Secretary of the Cardiff Business Club has called a South Wales Conference to appoint a delegation to wait on the Admiralty with a view to the reversal of the oil policy in favour of coal.

There must be few, if any, taking part in this conference who have an intimate knowledge of modern naval fighting units and what is required of them, otherwise they would know that their efforts, however well intentioned and commendable in furthering the cause of the coal industry, would be doomed to failure.

For naval requirements, the advantages of liquid fuel over solid, or fuel in pulverised form, are so overwhelmingly great as to rule out any justification for a change back to coal in either of these forms. Without going very deeply into the technical aspects, it is apparent to all those familiar with the problem that far greater fuel economies are possible from the use of oil, with the consequent saving in weight and space and corresponding increase in speed and range of action, the latter by as much as 40 per cent.

It may be safely stated that it would be impossible to construct war vessels of equal fighting value of the same displacement on a coal-burning basis. So long as oil remains the fuel of other navies, oil, however derived, must be the fuel of ours. The sooner the real facts are learned by those would-be helpers of the coal industry, whether in the form of Members of Parliament, committees of business men or individuals representing the general public, the better, lest these, agitating collectively, influence a Government towards a policy which might ultimately be the cause of a national disaster.

East Barnet, April 18th. E. F. Truscott, M.I.E.I.

THE "QUEEN OF SCOTS" TRAIN.

Sir,—Is it invariably necessary for someone, in this instance Mr. W. B. Thompson, to belittle every good performance on the part of a British railway? If so, the comparison used for this beneficent purpose ought to be so presented as to be informative. Mr. Thompson assumes that a regain of 62 minutes between Marseilles and Havre is self-evidently better than one of 18 minutes between Leeds and King's Cross; but, assuming—I have not the exact figure by me—that the former distance is about three times the latter, there is not much difference, in regain per unit distance. The French train may have got back some of its time in reduced waits at stations, whereas the English run is non-stop. Further, despite Mr. Thompson's sneer at the L.N.E.R., the "Queen of Scots" is booked over the stage in question at the respectable rate of 54·6 m.p.h.; if the French train's bookings are those of the usual P.L.M. express, the speed will be nearer 45 than 55. These leisurely timings are given with the object of allowing just such recoveries of time as that which so gratified Mr. Thompson, without the need of averaging "even time" for the whole distance as the "Queen" did. Horace Myers, Major.

London, April 20th.

HEAVY-OIL AIRCRAFT ENGINES.

Sir,—In the account of the discussion on the paper presented by Dr. Davies and Mr. Giffin on "Injection, Ignition and Combustion in High-speed Oil Engines" in your issue of April 10th, it would appear that I stated that the type test on the Junker heavy-oil aircraft engine had been carried out at altitudes of over 20,000ft. The reference I made to this altitude was quite independent of the test figures mentioned, which were, of course, effected in the usual way on a dynamometer, and concerned a *subsequent* flight test after the engine had been installed in an aircraft. G. P. Sulman, Major.

London, April 21st.

INSTITUTION OF MINING AND METALLURGY.

The annual dinner of the Institution of Mining and Metallurgy was held at the King Edward VII. Rooms, Hotel Victoria, W.C. 2, on Wednesday evening, April 22nd. The chair was taken by the President, Mr. J. G. Lawn, and close upon one hundred and sixty members and guests attended. In the regretted absence through illness of Mr. A. Chester Beatty, Sir Auckland C. Geddes proposed the toast of "The Institution of Mining and Metallurgy." He drew attention to the increased technical efficiency of mining and metallurgical operations, and asked those present to pause and think of the diminished employment and the increased leisure which the extended use of machinery inevitably brought with it. The movement towards increased efficiency must go forward, he said, but the human problems of unemployment and the right use of leisure still awaited a final solution. He assured the Institution that the City companies and boards had a real interest in their projected Westminster home, and would increasingly show that interest when the present depression had passed. In replying to the toast, Mr. Lawn spoke of the great age of the mining profession, and recalled the exact description of mining operations given by the author of the Book of Job. The poet Wordsworth, in "The Excursion," had stressed the quality of perseverance in the miner, and that quality was needed, Mr. Lawn suggested, in preparing for the revival of trade which would take place in due course. The toast of "Our Guests" was ably proposed by Mr. W. Pellew-Harvey, President-elect, and Sir Halford Mackinder replied. In the course of his speech Sir Halford announced that the suggestion made by the Secretary of the Institution, Mr. McDermid, four years ago, that the mineral resources of the British Empire should be surveyed, had now led to a practical plan which was agreed to at the last Imperial Conference, and a committee would be appointed under the chairmanship of Sir William Larke. Sir David Milne Watson, President of the Institute of Fuel, who spoke in the absence of Sir Evelyn A. Wallers, who had been unexpectedly called to Spain, referred to the projected Westminster home for the Institution and other scientific societies, which, he said, would become a reality, he felt sure, in a few years time. He asked every member of the various societies to do his utmost to help the scheme forward.

A new technical college is to be built in Coventry, at a cost of £142,275.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Unchanged Conditions.

TRADING conditions in the iron and steel industries of the Midlands and Staffordshire have not been materially affected by last week's quarterly meeting, which failed to produce either business or signs of trade revival. The market was restricted in all branches, and so it has since remained. Ironmasters and steelmasters alike have difficulty in disposing of their curtailed output, Midland manufacturers requiring but little raw material to execute the orders on their books. With the new quarter, however, has come renewed strength, and although industrialists are not banking upon the prospects of a revival in trade in the near future, and although there is little in this area upon which to base optimism, they are inclined to take a more cheerful view of the future.

Pig Iron.

Midland blast-furnacemen who had hoped for improved business from foundrymen and forgemen at last week's quarterly meeting and for some abandonment of the policy of hand-to-mouth buying, were disappointed. Outside the orders from the pipe foundries there was little buying of raw iron and practically no new contracts were entered into. Inquiries amongst district users of pig as to prospects did not encourage optimism, and the market was as drab and cramped as it has been for months now past. Were it not for the continued activity at the pipe foundries, the outlets for Midland pig iron production would be poor indeed. Forges and foundries are only partially employed and orders come along irregularly, and are of relatively small content. Some smelters in this area are still concerned respecting the stocks on their hands, but while it has become necessary recently to reduce the number of furnaces in blast, no further retrogression is anticipated. Producers of pig iron adhere strictly to the prices fixed by their Association, and the small amount of sales made this week have taken place at the quoted rates of £3 11s. for Derbyshire and North Staffordshire No. 3 foundry, and £3 7s. 6d. for Northamptonshire. Values of forge iron are, likewise, unchanged. Some hematite is being used in this district, both Welsh and East Coast, but the Welsh makers have the advantage with the lower transport charges. The prospects of foreign competition in foundry material in this market remain negligible.

Finished Iron.

The dullness of the finished iron trade in South Staffordshire has been enlivened a little this week by slightly improved orders and inquiries for strip and bars. Although it remains very difficult to secure orders, the new quarter has renewed hope in many breasts, and even this week's tiny fillip may be a pointer towards trade recovery. As such, it is welcomed, and ironmasters trust it will grow. While mills engaged upon the production of best quality bars and those turning out strip have an improving outlook, those making Crown quality iron or bars for the nut and bolt trade are in a deplorable position from which there seems little likelihood of their being shortly released. Demand in these branches is almost dead, and though quotations have been reduced again and again in an effort to stimulate buying, it has not been amended. On 'Change in Birmingham this week makers from other districts offered supplies of Crown bars at £9 12s. 6d., and even less, but they failed to attract buyers. Staffordshire ironmasters who assert that they could not make a profit if they accepted such a price, therefore, have small prospect of getting any business which may become available. In the common bar department the position is much worse, for there Belgian iron is to be had at little more than half the cost of Staffordshire material. Marked bar prices are fully maintained at £12 10s. per ton, as are tube strip values at £10 17s. 6d. Strip mills in this area are moderately well employed, and this branch is probably the brightest part of the Staffordshire iron trade at date.

Steel.

No alteration has taken place in the finished steel department of the Midland market. Last week's quarterly meeting added very little to steelmasters' order books, and specifications since then have been notably scarce. All the heavy engineering industries in this area are short of work, and while constructional engineers and rolling stock makers are both anticipating improvement in their respective trades, small tonnages of material are sufficient at the present time to satisfy their needs. It is stated that some of the big engineering firms hereabouts have rarely had to contend with such a scarcity of new business as faces them to-day. The Steel Manufacturers' Association, having reaffirmed the prices of sections, joists and plates, together with the rebates allowed to consumers exclusively of British material, there is now little interest in finished steel values. It is fairly certain that the selling rates laid down will be strictly adhered to. In the half-products branch values continue on a downward course, a fact due in no small measure to severe competition from the Continent. This week, in Birmingham, small steel bars rolled from imported billets were sold at £7 per ton, and reports were current of business being done even below this figure. Competing foreign material was on offer at £4 15s. to £5 per ton. Bars rolled from native material were to be had at about £7 5s. per ton. British mild steel billets were quoted £5 5s. delivered, while continental billets were named £4 8s. 6d. to £4 10s. per ton. Native steel strip sells fairly freely at £7 per ton upwards. There is but little business available for either British or foreign steelmasters.

Galvanised Sheets.

The dullness of the glavanised sheet trade is unrelieved. The price is unchanged at £11 per ton for 24-gauge. Though there is still a great dearth of orders from export markets, interest appears to be re-awakening in the West Indies, India and South America. Inquiries from these sources have increased considerably, and while, up to the present, the business which has arrived has not been large, it holds out hope of improved trade for the sheet mills in the near future. Local mills are far from well employed, and they welcome even the smallest orders. Rolling is much below capacity. Black sheets are in growing demand, but automobile engineering firms are not so well placed as is customary at this time of the year, and the tonnage of sheets required is below normal. Values show no change.

Trading Accounts.

The returns of imports and exports for the month of March are not at all satisfactory, in so far as iron and steel are concerned, for they show that for the past six months our exports of these materials have been less than our imports. The balance has steadily moved against us, the difference in the past quarter being approximately 128,000 tons, representing more than 25 per cent. of our turnover. Comparatively little foreign material has of late come into the Midlands, but that is owing to the general poorness of consumptive demand as a result of the trade slump and not to any increased controlling influence on the part of the home producer. The trade returns present, however, at least one pleasurable feature. The March exports of railway material were greatly improved. The tonnage shipped overseas was considerably more than that shipped in January and February combined, but it was nothing like as large as in March last year.

Encouraging Signs.

It is some encouragement to learn that the daily rate of pig iron production in March was practically the same as February—357,100 tons in March, compared with 318,200 tons in February. It appears to indicate the possibility of an arrest of the decline which has been so marked of late. It is not forgotten, however, that the output in March a year ago totalled some 665,800 tons. The number of blast-furnaces in operation at the end of March was 81, the same number as at the beginning of the month, three furnaces having ceased operation and the same number having commenced, which is again fairly satisfactory. The past month's production included 95,600 tons of hematite, 131,200 tons of basic, 100,800 tons of foundry and 16,100 tons of forge pig iron. The March output of steel ingots and castings amounted to 500,100 tons, compared with 486,400 tons in February and 826,100 tons in March, 1930.

Sub-station Equipment for a London Tube.

It is announced that the General Electric Company, Ltd., Witton Works, Birmingham, has secured the contract for the complete equipment of four new traction sub-stations for the London Electric Railway Company at Sudbury Hill, Alperton, North Ealing and Northfields. The equipment comprises a total of ten 1500 kW remote-controlled, mercury-arc rectifiers, operating from an 11,000-volt, three-phase supply, and feeding the traction system at 630 volts D.C., together with the whole of the automatic control gear, air-blast transformers, high-speed circuit breakers, cabling, lighting, &c.

Water Engineers Visit Coventry.

One hundred and seventy-five members and friends of the Institution of Water Engineers gathered at Coventry on Saturday last for their informal Spring Meeting and to inspect various works in connection with the reorganisation of the city's water undertaking. They were accorded a civic welcome by the Mayor of Coventry (Alderman W. H. Batchelor), and after luncheon at St. Mary's Hall, the guests visited the Brownshill Green Pumping Station, Meriden reservoir, Arnold Farm water tower, and Spon End pumping station. The Meriden reservoir has an internal diameter of 280ft. 6in., a normal depth of water of 25ft. 6in. and a capacity of 10,000,000 gallons. It will be supplied with water pumped from the Whitacre pumping station of the Birmingham Corporation, the Watery-lane and the new Brownshill Green pumping stations of the Coventry Corporation and the Coventry Colliery.

Obituary.

A well-known figure in the Black Country iron trade has been removed by the death on Friday last of Mr Christopher Darby, of Corngreaves-road, Cradley Heath. For seventy years he was actively connected with the iron trade in this district, having held a responsible position with the New British Iron Company at Cradley Heath for thirty-five years. When the Corngreaves Works closed down, he started business on his own account and built up a flourishing concern. Mr. Darby, who was eighty-three years of age, took an active part in the public, religious and social life of the district in which he lived. The death also took place last week at Streetly, of Mr. John Langford Ridsdale, who was well-known in Midland industrial circles as a mining engineer. He was seventy-six years of age and was managing director of the Tamworth Colliery Company, Ltd.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

A Poor Quarter.

HANDICAPPED as they are in the home markets, textile machinery manufacturers will find little to comfort them in the tendency of export business. For the three months ending March, shipments of textile machinery from this country were almost exactly half what they were in the corresponding period of 1930, the respective aggregates being 12,287 tons and £1,267,117 and 26,681 tons and £2,539,447. The returns for March displayed no indication of recovery from the extremely low figures of the two previous months. The decline has been general in all markets, the only possible distinction being the extent of it. It is instructive therefore to give the quarter's figures for each of the principal markets, with the corresponding totals for the three months of last year in parentheses. Notwithstanding the serious decline in shipments to India, owing in no small measure to political factors, that country is still easily the leading market for British textile plant with exports valued at £417,304 (£757,142); France comes second at £134,020 (£216,076); followed by China with £100,458 (£196,552); Germany, £56,575 (£112,352); Russia, £53,322 (£221,004); the Netherlands, £50,040 (£96,920); South America, £48,346 (£78,747); the United States, £41,522 (£103,751); Japan, £20,075 (£176,153); and Australia, £13,242 (£73,606); aggregate exports to "other European countries" amounting to £244,901, compared with £382,393 in the first three months of last year.

In Pounds, Shillings, and Pence.

The financial effects of the depression in textile engineering are reflected in the accounts for the twelve months ending March issued by Howard and Bullough, Ltd., textile machinery makers, of Accrington. Against a profit in the year 1928–29 of £71,447, and a small one of £1610 in 1929–30, a loss of £41,176 has been sustained during the past year. Debenture interest and the dividend on the preference shares were paid with the help of the reserve fund. In 1928–29 holders of the ordinary shares received a dividend of 8¾ per cent., and in 1929–30 one of 2½ per cent., but no distribution on this class of share is to be made for the year just ended.

Order Book Additions.

An important contract secured by the Pearson and Knowles Engineering Company, Ltd., a constituent of the Lancashire Steel Corporation, is for the fabrication and galvanising of 6000 tons of transmission towers for the South-West England and South Wales electricity scheme. The contract is valued at more than £100,000, and has been placed with the Pearson and Knowles Company by Milliken Brothers, Ltd. Crossley Brothers, Ltd., have secured an order from the British Broadcasting Corporation for four vertical oil engines, each of 350 B.H.P., for installation in the new Scottish Regional Station at Falkirk. The new engines are said to represent the latest development in the design of the vertical compressorless oil engine.

A Business Notice.

New offices and laboratories have been built at Cheadle Heath, near Manchester, by Simon-Carves, Ltd., engineers, to accommodate their technical and commercial staffs. For more than forty years the firm has occupied offices in Mount-street, Manchester, but these offices have been acquired by the London, Midland and Scottish Railway Company for the purpose of carrying out important extensions to the Midland Hotel. The transfer of the staffs has now been completed.

Non-ferrous Metals.

After the slight recovery in copper and lead, another black week has been experienced on the market for non-ferrous metals, weakness having developed in every section. Tin has been by far the worst sufferer, and it is now fairly obvious that any strengthening effect that may have been expected from the new output restriction arrangement has been fully discounted for the time being. The demand for the metal has been disappointing all round, stocks are increasing, the statistical position is expected to become more bearish, and speculative operations have added to the quota of the tin section's troubles. The net result has been a loss on balance compared with a week ago of nearly £5 a ton, with the market at the moment of writing distinctly weak. In the case of copper, an improvement in the demand from consumers, principally in the United States, served to stiffen prices somewhat, but the spurt was short-lived, and the whole of the ground gained has been lost, current values being lower by about 15s. a ton for standard brands. At the producing end, the present position is slightly better than it was at the worst, but stocks of the metal are extremely heavy, and a material expansion of the demand will be necessary before there is a return to a really stable market. Lead producers, at a meeting this week in London, agreed to curtail output by 15 per cent. below last year's figures for a minimum period of six months, beginning with May, but, as with tin, the news had already been discounted, and quotations are lower on the week by 5s. a ton. In the meantime, the demand in this section remains distinctly moderate. Spelter has experienced a further substantial decline and sales are restricted.

Iron and Steel.

Conditions on the local iron and steel markets are quiet in all departments. Inactivity at the consuming end, coupled with the extremely low figures at which scrap is being offered, has curtailed the demand for foundry iron to very small proportions, although sellers are hopeful of some degree of improvement within the next fortnight. Staffordshire, Derbyshire, and Cleveland irons are all quoted for delivery equal to Manchester at 69s. 6d. per ton, with Northamptonshire at 68s., Scottish at about 88s. 6d., and West Coast hematite at 82s. 6d. Lancashire bar iron makers have not, up to the time of writing, revised their quotations, which remain at £10 5s. per ton for Crown bars and £8 15s. for No. 2. Sales in this section are on strictly hand-to-mouth lines. Lancashire constructional engineers, boilermakers, and locomotive builders are almost all of them engaged at below capacity, and with little immediate prospect of improvement, contract buying is virtually neglected, rolling programmes being the basis of the majority of orders. Apart from small re-rolled bars, which are quoted at £6 15s. per ton, and boiler plates at about £9, other steel products are maintained at the late rates.

Building Trades' Exhibition.

At the twelfth Exhibition devoted to the building trades, which is being held this week at the City Hall, Manchester, there are some noteworthy exhibits of machinery in motion by the principal makers of woodworking appliances. The outstanding feature on all these stands is the universal application of the self-contained electric motor drive with push-button controls. The electric motor lends itself admirably to the high speeds required for woodworking moulding machine spindles, running at speeds as high as 6000 revolutions per minute. Amongst the firms who are exhibiting in this section are Thos. Robinson and Son, Ltd., Rochdale; John Pickles and Son, Ltd., Hebden Bridge; J. Sagar and Co., Ltd., Halifax, and Wadkin and Co., Leicester. John Fowler and Co., Leeds, are showing concrete mixers and builders' appliances.

BARROW-IN-FURNESS.

Hematite.

There has been no movement in the hematite pig iron market during the week. Trade remains as it was, and not very bright at that. True, it is a little better than it was a few months ago, but there is still any amount of room for improvement. The fact that the local steel works continue to take delivery is responsible for the absorption of the present output, but there is over 100,000 tons in stock awaiting buyers, and from present signs it will be a long time before there is any appreciable reduction. Buyers are content to place orders of small tonnage sufficient to meet immediate requirements, and there is still little tendency to place orders for forward delivery. The home demand is steady, but small. The trade with the Continent is on the quiet side, and American business is not a prominent feature by any means. Iron ore continues in quiet demand. The steel market is dull, and as far as Barrow is concerned the present position is hand-to-mouth. Hoops and bars are in better demand than rails. At Workington rails and sleepers are being turned out, but not regularly. Still, the Cumberland mills have orders to take them to the end of May or even into June.

Shipbuilding.

The cable from Portugal to the effect that the Government of that country had placed an order with Vickers-Armstrongs for two dispatch vessels, together with armaments, &c., for four destroyers, to be built by Yarrows, lacks official confirmation. Some work from Portugal is expected, but up to the present it has not been possible to state definitely if it has been given out. Barrow certainly hopes to receive some of this work, and that is all that can be said at present.

SHEFFIELD.

(From our own Correspondent.)

Still Losing Ground.

THE long-cherished hopes of an improvement in the Sheffield steel trade are still deferred, and their realisation seems further off than ever. Not only is there no advance to report this week, but it is to be feared that more ground has been lost. The number of businesses that are able to show a fair turnover is almost negligible; on the other hand, complaints of shortage of work and orders are general. The position as a whole is worse than it was a month ago, and the depression continues to spread. Firms engaged on the production of open-hearth steel are down to very small outputs, and have difficulty in disposing even of them. Forward business is so scarce, and so lacking in bulk that the future is very uncertain. At the large works of Steel, Peech and Tozer, belonging to the United Steel Companies, production was completely suspended for ten or eleven days at Easter. Any hope that this course would result in an accumulation of orders was disappointed, for when the works restarted only the same number of furnaces were put into operation as before the stoppage, namely, five out of fourteen at Templeborough and one out of eight at Rotherham. The local figures of production for March are not yet available, but, judging by the national returns, it is not likely that, when published, they will be satisfactory. The total production of steel ingots in the country last month was 500,100 tons, which, although a little in excess of the February figure of 486,400 tons, is no less than 308,000 tons down on March of last year, and 138,000 tons less than the monthly average of the last pre-war year.

Railway Material.

The depressed state of shipbuilding and the reduced traffics on the home railways, with consequent lessening of the wear and tear of stock, are causing a great loss of work to Sheffield. The distribution of the Boxer Indemnity Fund has not brought any Chinese railway work to the city yet, but orders from this source cannot be far off. One local works is making a moderate-sized steam hammer to be paid for out of the Fund. An order for railway carriages for Siam has recently been placed in Japan, which is not cheering news for Sheffield, as those vehicles have hitherto been made in England, and this city has had a good share of them. Siam is buying rolling stock in Belgium. A moderate amount of axle, tire, and spring work is on hand for South Africa and South America, but the quantities are much less than the average of past years. The Crown Agents for the Colonies have ordered tires from John Baker and Bessemer, Ltd., Rotherham, and the United Steel Companies, Ltd., Sheffield.

The Lighter Trades.

The trade in high-grade Sheffield steels has felt the depression more acutely this year than at any previous period. This is largely owing to the serious falling off in the overseas demand. The last two or three months have seen reductions in the wages and salaries of large numbers of workmen and staffs in Sheffield, and the movement is extending to nearly all the principal industries. Owing to the weakness in the tool and special steel branches, the market for ferro-alloys is in a disorganised state, and consumption is at the lowest point known since the war. There has been a reduction of 3½d. per lb. this month in the price of tungsten. The saw and file branches are acutely depressed. Makers of farm and garden tools have had a fair season's sales in the home market, the quantities being not far short of last year's, but the extent to which dealers will clear their stocks during the next few months remains to be seen. The fall in exports has been very marked.

Use of Steel in Pits.

The references to the value of steel in coal mines at the Safety in Mines Conference a week ago, with their note of encouragement for the local steel industry, were followed by others at a meeting of the Midland Institute of Mining Engineers in Sheffield last week. Mr. J. Brass, of Houghton Main Colliery, in introducing a report on the control of roof and support of mine workings—based on investigations made at four large collieries working the Barnsley seam—said it was noteworthy that in some cases steel arch girders had been introduced successfully, with a consequent saving in both first cost of making crossgates and permanent roadways, and in their subsequent maintenance. It was also significant that the accident rate was lowest at the colliery where the roof at the coal face was supported entirely by steel props.

Sheffield Rolling Mill for Spain.

A contract for steel works equipment of an unusually important character has just been completed by the Brightside Foundry and Engineering Company, Ltd., of Ecclesfield, near Sheffield. It consists of a complete rolling mill, with all the auxiliary equipment, designed and manufactured for a firm in Barcelona which specialises in the rolling of large sections and joists for constructional purposes. The installation left Ecclesfield last week for shipment to Spain, being conveyed to Hull in a train of thirty-four trucks. The total weight of the load was 250 tons. The installation is of the most modern design, and comprises a 26in. reversing rolling mill, live roller gear tables, hydraulically operated manipulators, an electrically driven hot bloom shear, broadside transfer, hydraulic pumps, and accumulator. The mill train is driven by a 1620/5850 H.P. motor, and the whole of the plant is controlled by two men on the operating bridge, through the medium of suitably grouped levers. After being rolled in the 26in. mill, the bars are skidded across the broadside transfer to the existing mill, in which the material is finished to produce the required sections, the existing mill being coupled to the new mill through universal mill spindles.

A Smokeless Steel Furnace.

One of the difficulties in the way of abating the emission of black smoke in Sheffield hitherto has been connected with sheet mill furnaces, which do work of such a special character that the regulations regarding them have been lenient. Now, however, the difficulties appear to have been removed by the invention of a furnace which obviates the production of black smoke. It consumes all its own smoke, and, in addition to that, substantial economies are claimed for it. The furnace is the invention of Mr. H. Sykes, chief engineer of the firm of Jonas and Colver (Novo), Ltd. He has been working on the idea for at least ten years, but until recently he had no opportunity of putting it to the test. However, an old furnace at the Neepsend Rolling Mills, Sheffield, had to be reconstructed and it was decided to incorporate the invention. The new furnace was visited last week by local smoke abatement officials and others, who expressed considerable satisfaction with it. Mr. Sykes explained that all the smoke is burnt. Some people, he said, thought that as a result the incandescent flame produced would destroy the structure of the steel, but the furnace had now been working for three months, and there had been no complaint about the finished article. Instead, the output had been increased by at least 25 per cent., and the fuel consumption had been reduced in proportion. Not only had smoke been eliminated, he added, but the efficiency and capacity of the furnace had been increased. What used to be the waste gas is now surplus gas, which is passed into the hot fire and burnt.

An Improved Brake Tester.

The brake testing of mechanically propelled vehicles is becoming increasingly important. An apparatus which will quickly and accurately make tests of vehicles is of considerable value, not only to users, but also to those responsible for the safety of the highways. At Laycock's Engineering Works, Millhouses, Sheffield, last Tuesday, a number of motor users and Corporation officials witnessed experiments made with the improved L.S.D. brake tester working under actual road conditions. Cars were driven on to the tester at varying speeds of 1 to 15 miles per hour, the brakes being applied when all wheels were on the platform, causing the braking effort of each wheel to be simultaneously and independently registered on a gauge which remained fixed for inspection of the readings. The L.S.D. tester is not unlike a weighbridge in appearance, with a dial gauge in place of the steelyard. There are two models, one for motor cars and the other for commercial vehicles. The efficiency and utility of this type of tester is shown by the fact that car drivers can do their own testing and accurately gauge the condition of their brakes in a few seconds.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

APPREHENSIONS regarding the Budget are sufficient in themselves to account for the lethargy of the Cleveland pig iron market, but it is becoming increasingly apparent that if prices are kept at their present level there can be little hope of much business outside the immediate area. In Scotland, despite the specially cut rates quoted, Cleveland makers cannot compete on level terms, and export orders are few and far between. Local consumers are also strictly limiting their purchases, and, in some cases, adhere to the belief that prices must fall. The ironmasters, however, offer no encouragement to this view. Producers have not a great deal of Cleveland iron stored at their works, but heavy stocks of hematite are lying at certain blast-furnaces. One firm of hematite producers, believed to have on hand something like 40,000 tons, refuse to sell at anything like rates now obtainable. Of the 88 blast-furnaces on the North-East Coast only 21 are in operation, seven of which are making Cleveland pig iron, five producing hematite, and nine other kinds of iron. For the home trade, No. 1 Cleveland foundry is 61s.; No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s.

Hematite Pig Iron.

East Coast hematite values are distinctly easier, although makers are reluctant to acknowledge an actual fall in quotations. Merchants, by cutting prices, succeed in disposing of occasional small lots to customers abroad, but are not at liberty to undersell makers in home markets. Ordinary brands are on offer at 66s. 6d., and other qualities are quoted in proportion, but buyers state they can place orders on lower terms.

Ironmaking Materials.

The foreign trade shows no signs of animation. Sellers still name 16s. as the c.i.f. price of best Rubio, but would, doubtless, take less. Durham blast-furnace coke is in ample supply, though production is less than it has been. For early delivery of good average qualities to consumers in this area the quotation remains about 16s., but sellers would not enter into contracts on forward account except at higher rates.

Manufactured Iron and Steel.

There is no new feature of moment in the manufactured iron and steel trade. Nearly all branches are much in need of work, sections engaged on shipbuilding material being particularly short of orders. In the heavy steel trade, producers of railway requisites have a fair amount of work to execute. Quotations are well maintained.

The Coal Trade.

Coalowners in the North of England are keenly interested in the developments that are taking place with respect to the production of oil from coal. Oil fuel from coal as cheap as petrol holds out an alluring prospect for the counties of Northumberland and Durham. It is a subject that has often been discussed, and it appears that it is nearer the stage of realisation. There is every sign of a systematic concentration upon the production of oil from coal, and definite proposals by the Government to the House of Commons are expected at an early date. If coal fuel can be made an economic possibility, it may change the entire position of the mining industry in this area. The potential output of coal in the two counties is much greater than most people conceive. The only change of note this week is an easier feeling in Durham bunker coals. The immediate demands appear to have been met. Northumberland qualities, however, report a good turn. The heavy demands under old bookings for this month's deliveries of every description of steam coal keep prices at a firm level. Forward, too, the inquiry is brisk, but actual bookings are very limited owing to the severe competition from abroad for all available business. April prices are thus quite firm, but the prospects for next month are dull and easy. Buyers can cover any required commitments at about the low level of the fixed minimum. Best Northumberland steams for prompt are firm at 13s. 9d., but forward 13s. 6d. to 13s. 9d. is the general quotation. Second classes of steam coals are not so well placed for trade, but prices are upheld. In the Durham gas coal trade the minimum prices are said to be an impending factor in securing foreign orders. There is no disposition to interfere with the general range of values, but here and there prices of some grades have been revised. Northumberland coals seem to have stood the test of minimum prices better than certain grades in the neighbouring county; hence, the occasional revisions. Gas coals are slower in request than at the beginning of the month, but prices are tolerably well maintained. The best grades are getting the better share of the business at 14s. 9d. to 15s. Secondary grades are at 13s. 3d. to 13s. 6d. Home business has been instrumental in maintaining a state of briskness in Durham gas coal, but there is no certainty that it will continue in its present volume, as it has been obtained of late largely at the expense of other districts, which are likely to adjust their conditions so as to recapture what they have lost. The recent trend of firmness in blast-furnace coke has disappeared, and the tone is once more easy. There is no improvement in ordinary patent foundry coke, which is freely offered at 15s. 6d., with higher brands asking 16s. There is no forward trade to test values. Gas coke has no show of strength at 20s. to 20s. 6d.

SCOTLAND.

(From our own Correspondent.)

Scarcity of New Business.

WHILE reports seem to indicate a slight improvement in certain directions, the general scarcity of business in steel, iron and coal is as pronounced as ever. Overseas buyers of steel and iron recently appeared to be taking more interest, but firm business has failed to show any expansion so far. The general outlook remains dull.

Steel.

The scarcity of specifications for heavy steel, especially for shipbuilding purposes, continues one of the

outstanding features of the trade. Outputs of plates and sections have decreased gradually, and now the reduced tonnages increase the cost of production unnecessarily. Steel sheets have experienced a slightly better demand for export for both black and galvanised descriptions, more especially the former. Producers are now more hopeful with regard to the Indian market but continue to deplore the attitude of Australian buyers. All descriptions of tubes, and more particularly small diameter descriptions, are in poor demand. Demands for structural steel have been more prolific of late, and some good orders are in prospect.

Manufactured Copper Reduced.

The price of manufactured copper has been reduced by £2 per ton, making the basis quotation for strong £75 per ton.

Iron.

Bar iron and steel re-rollers have not improved their position and outputs are seriously curtailed. Seasonal developments in respect to the first-named have been far below expectations, while the latter is adversely affected by continental and English competition. Bar iron is unchanged and re-rolled steel bars remain round about £6 10s. home and £6 7s. 6d. per ton export.

Pig Iron.

The output from the seven furnaces in blast is still more than sufficient to meet all demands. Shipments last week amounted to 468 tons (195 tons foreign), compared with 1190 tons (1130 tons foreign) in the same week last year.

Scrap.

Scrap material is in poor demand, and prices are easier at 53s. 6d. for cast iron machinery and 45s. per ton heavy steel.

Coal.

In view of the advance of the season, the demand for coal for home consumption is rapidly declining. More fuel is becoming available for the shipping market, but exporters are not able to entertain forward transactions at present prices, and business is still confined to small prompt lots. Lanarkshire splints and best Fifeshire steams are comparatively steady, but other fuels are tending easier. Treble and double nuts are fairly firm, but smaller sizes are very plentiful at reduced prices. Aggregate shipments amounted to 185,178 tons, against 201,384 tons in the preceding week and 216,665 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

IT is somewhat of a disappointment to the steam coal trade that the Egyptian State Railways have not bought the full quantity of locomotive coals for which they recently asked for tenders. Their inquiry was for 300,000 metric tons for delivery at Alexandria from June to September, but from the information to hand they have only closed for 100,000 tons, this contract having been placed with the Maris Export and Trading Company, Ltd., on the basis of 80,000 tons at 25s. 5d. and 20,000 tons at 25s. 1½d. per ton c.i.f. Alexandria. It remains to be seen whether the railways will come in the market later for additional quantities. Other contract business is comparatively quiet, but, still, it affords some satisfaction to find that the political developments in Spain have not disturbed operations between that country and South Wales, as it is reported that the Andalucian Railways have bought between 8000 and 10,000 tons of coal for prompt shipment, while the Norte Railways are in the market for about 12,000 tons of steam coals for fairly early delivery. The Barcelona Sugar Works, which recently came on the market for supplies, are reported to have placed orders for the bulk of their requirements with native coal producers, only two cargoes being awarded for Welsh coals. So far as current market conditions are concerned, the tone for most descriptions is very steady. As expected, shipments last week from the ports under the control of the Great Western Railway Company displayed a marked improvement. The total came to 513,000 tons, which compared with 315,400 tons for the preceding week and with 429,418 tons for the corresponding week of last year. The tonnage situation last week was unusually good, though, by the time Saturday was reached, the number of idle tipping appliances was 26, and four steamers were waiting. The position this week is not so satisfactory, as tonnage had not come along sufficiently well to reduce the number of idle appliances, so that it is very unlikely that shipments this week will come up to those of last week. One noticeable feature is the improvement in the returns for Swansea and Port Talbot. This is probably accountable by the fact that the loading of anthracite coals for Canada are now proceeding on fairly active lines.

Coal *versus* Oil.

The conference of all interests in this district to further the movement for the displacement of oil by coal in naval vessels is to be held at Cardiff to-day—Friday. Meantime, the agitation proceeds apace. The subject was discussed at a meeting of the Executive Council of the South Wales Miners' Federation at Cardiff last Saturday, when Welsh Members of Parliament were also present, and, in addition, Mr. George Hall, the Civil Lord of the Admiralty, attended. Mr. Hall gave a very informative statement on the position, and the meeting was much impressed with the arguments put forward that the Government should concentrate upon the production of oil from coal rather than attempt to enter upon what would prove to be a long and expensive procedure of converting oil-burning naval vessels to coal burners. Mr. Hall informed the meeting that the Navy uses annually about 1 million tons of oil fuel, and to secure that quantity 20,000,000 tons of coal would have to be distilled. He believed that the Navy could be supplied with oil from coal at a little more than the price of the fuel oil which is now used. It is understood that the miners' representatives who attend the conference to be held to-day—Friday—will put forward views on the question in accordance with the position outlined above rather than advocate at there should be a reversion to coal-burning ships.

Steel Trade and Protection.

About 10,000 operatives were represented at the annual conference of the Tin-plate Section of the Transport and General Workers' Union, held at Swansea on Saturday, when, following upon an address by Mr. Ernest Bevin, the general secretary, a resolution was passed calling upon the Government to take immediate steps to place the steel trade under public utility ownership. The resolution expressed resentment at the attitude of those now controlling the industry, viz., that they will not take the necessary steps to put the industry in a proper state until Parliament grants a tariff. The resolution further set forth the view that the conference was satisfied from past experience that while a tariff would prove futile as a solution of the problem, it would endanger, if not ruin, the finishing end of the trade in the export markets. The conference also decided to adopt the principle of 6-hour shifts in the tin-plate trade generally, instead of 8 hours, in order to absorb men at present unemployed. Since then, Mr. W. Simons, director of Guest, Keen and Nettlefold's, Ltd., has described the resolution passed at the conference of the men's union as one of the biggest travesties of fact he has ever read. Those engaged in the steel industry have spent enormous sums of money during the past six or seven years in modernising plant, but a return to prosperity he described as impossible as long as the industry has to contend with foreign imports to the extent of 3,000,000 tons of steel per annum, as against 8 million tons produced annually by the home industries. According to Sir John Beynon, director of the Ebbw Vale Iron and Steel Company, Ltd., they cannot think of re-starting the Ebbw Vale steel works until they get a tariff.

Tin-plate Prices and Wages.

According to the ascertainment under the sliding scale agreement governing wages in the Welsh tin-plate trade for the quarter ended March 31st, the average net selling price per basis box of tin-plates, after deducting the cost of steel bars and other adjustments, was 8s. 2·91d. This compares with 8s. 11·76d. in the previous quarter, and will involve a slight decrease in wages during the three months ending August 1st.

Mannesmann Tube Works.

The workmen who were employed by the British Mannesmann Tube Works have received a letter from the company stating that they are prepared to consider the reopening of the works on a restricted basis if a sufficient number of the men will intimate that they are prepared to accept the company's terms. These involve the working of two shifts of 47½ hours per week, allowing Saturday and Sunday as two clear rest days. The proposals do not involve a reduction in wages, and the company points out that the terms and conditions are better than those paid in the industry throughout the country.

LATER.

A mass meeting of the workmen on Tuesday decided to reject the terms of the company, and placed entire responsibility on the company for the closing down of the works without giving the award a trial.

Dowlais Steel Works.

Efforts are being made by the business people of Dowlais to persuade Guest, Keen and Nettlefolds, Ltd., to reopen their Dowlais-Merthyr Iron and Steel Works.

New Industry.

The complaint generally made is that new industries are required in this district and every effort is being made to encourage their development. One new works that is to be started in the course of the next few months is for the manufacture of wire and wire ropes. Mr. D. Morgan Rees, who is an outstanding figure in the wire rope business in South Wales, is at the head of the present development. A site of 5 acres has been obtained for the new works in the neighbourhood of Cardiff, and orders for plant and machinery have been given. These works are expected to be ready for production about next September, and will give employment to about 100 people.

Current Business.

Although, to all outward appearances, there is not much fresh business passing in steam coals, the majority of collieries are fairly well stemmed for early loading. All the leading qualities of large coals are comfortably placed, and in the case of some of them, including Monmouthshires, a premium of 3d. to 6d. above schedule prices are being quoted. It is quite possible, however, that tonnage may not be placed at the disposal of collieries quite as freely as could be desired, as difficulties are already being experienced in chartering suitable steamers for some directions, notably for Upper Mediterranean, owing to the fact that so much tonnage is being attracted to Canada and South American destinations. Owing to the favourable homeward rates prevailing, tonnage is being sent away in ballast. Sized coals are also very steady, but smalls show irregularity. The best descriptions of coke meet with a fair inquiry, but patent fuel is quiet. Pitwood is a shade steadier.

SOCIETY OF CHEMICAL INDUSTRY.

THE Jubilee Celebrations of the Society of Chemical Industry will be held in London during the week commencing July 13th, 1931. The proceedings will be under the presidency of Sir Harry McGowan, and will comprise scientific discussions, social functions, and visits to industrial centres. The celebrations will open with a reception by the Lord Mayor of London at the Guildhall. The annual general meeting of the Society will be held in the Duke's Hall, Marylebone, on Tuesday, July 14th, when Sir Harry McGowan will deliver his presidential address. In the afternoon a garden party arranged by the Shell Royal Dutch oil group will be held at Teddington. On Wednesday the Society's Medal will be presented to Dr. Herbert Levinstein and the annual dinner will take place at the Great Central Hotel, Marylebone. On Thursday evening the President will hold a reception at the Savoy Hotel. During the celebrations, honorary membership of the Society is to be conferred on representative leading members of the chemical industry in each of the world's principal industrial countries, and these distinguished scientists will deliver addresses during the week. The Canadian sections of the Society will read papers at the Great Central Hotel. Papers, lectures, and discussions will take place during the week. Visits will be paid to over twelve well-known firms. An exhibition of British chemical plant and research and recording instruments, arranged by the British Chemical Plant Manufacturers' Association, will be held at the Central Hall, Westminster. A section of the exhibition will be devoted to the work of the Department of Scientific and Industrial Research, and other research associations. The social side of the celebrations will include motor drives, river trips, and visits to places of interest.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE BENJAMIN ELECTRIC, Ltd., has been accepted by the Air Ministry as an approved supplier.

R. A. LISTER AND CO., Ltd., has converted "The Towers," the home of the late Sir Ashton Lister, into a private hotel, in order to accommodate their many overseas visitors.

DORMAN, LONG AND CO., Ltd., has appointed Mr. T. Mensforth, A.M.I.E.E., to the position of chief engineer. He will be in charge of the company's central engineering department.

ENGINEERING GOLFING SOCIETY.—The Spring Meeting of the Engineering Golfing Society will be held at Aldeburgh, Suffolk, on Saturday and Sunday, May 9th and 10th next. The following programme has been arranged :—On the Saturday morning there will be an 18-hole round—four-ball foursome match play against bogey—for the Timmis Challenge Cups, each player to take three-quarters of his handicap, fractions of one-half and over to count as one stroke. Mementoes and second prizes will be given. In the afternoon, there will be an 18-hole round—two-ball foursome match play against bogey—the stroke allowances being three-eighths of combined handicap, fractions of one-half and over to count as one stroke. Two first and two second prizes will be given. On the Sunday morning, the "President's Challenge Cup," for members in the First Division, with handicaps of 10 and under, and the "Wilson Challenge Cup," for members in the Second Division, with handicaps of 11 and over, will be competed for in an 18-holes stroke round under handicap. A memento and a second prize will be given in each division. There will also be prizes for the best scratch scores in each division, presented by the Captain. Members will be free to arrange private matches for the afternoon.

THE CREWE DINNER.—The forty-first annual dinner arranged by the Past and Present Crewe Pupils and Premiums was held at the Mayfair Hotel on Friday, April 17th. The numbers present followed the fashion of the day by "establishing a new record." Mr. H. N. Gresley occupied the chair and was supported on his right and left by Mr. Loughnan Pendred and Sir John Thornycroft. The evening was an entirely joyous one. No one made a long speech and no one made a serious one. Mr. Pendred led off by proposing "Past and Present Crewe Pupils and Premiums." Captain H. P. M. Beames responded on behalf of Past Crewe Men, and Mr. J. A. W. Knapman on behalf of Present Crewe Men. A light touch with a good deal of local colour made both responses delightful. Then Mr. Charles L. Mason handled the difficult toast of "The Guests" with deftness, and Sir John Thornycroft replied. "The Chairman" was proposed by Sir Martin Hall, and in his acknowledgment of it Mr. Gresley skilfully introduced a reference to the Secretary and organiser, Captain R. Terrel, who, following the tradition of the dinner, replied in a very humorous speech. . . . If all dinners were like the Crewe dinner, there would be less dyspepsia, which is the result of trying to listen to long, serious addresses, whilst perched on uncomfortable chairs, at the very moment when the digestive processes call for ease of body and no more than gentle titillation of the brain.

INSTITUTE OF MARINE ENGINEERS.—The thirty-fifth annual dinner of the Institute of Marine Engineers was held at the Connaught Rooms on Friday evening, April 17th, when over 600 members and their guests attended. The President of the Institute, Lieut.-Commander Sir August B. T. Cayzer, R.N. (Ret.), was in the chair, and carried through most successfully a varied and interesting programme, which included musical items interspersed between the speeches. The first toast, that of "Shipbuilding and Engineering Industry," was entrusted to Sir Frederick Mills, who, while expressing his profound belief in the high quality of British products and the capacity of our industries, thought that we might not share fully in the forthcoming world trade recovery if due economy was not observed, alike in Government, municipal and industrial undertakings. The same note was emphasised by Colonel Sir James Lithgow in his reply. Sir James spoke of the measures of reorganisation which had been adopted in the shipbuilding industry, and made the suggestion that other industries might follow the example which had been given. The standard of living had been increased and the standard of work should be increased too. It was only with energy, enterprise, and hard work that we could expect to continue to hold our leading position in world trade. In proposing the toast of "The Institute of Marine Engineers," Admiral of the Fleet Sir Charles Madden spoke of the remarkable influence which the steam engine and steam turbine had exerted on maritime affairs, both naval and mercantile. He paid a tribute to the genius of the late Sir Charles Parsons, and commented on the increase in reliability which the turbine had given. In his reply the President referred to the 3300 members of the Institute, and expressed the hope that this number would be greatly increased. He urged support for the movement for producing liquid fuel from British coal. Admiral of the Fleet Earl Jellicoe gave the toast of "H.M. Dominions Overseas and the Mercantile Marine," and spoke on the essential services which were rendered by the Royal Navy and the mercantile marine overseas. Lord Stonehaven responded to the toast, and the chairman was thanked by Vice-Admiral Sir R. Mansell. A programme of music and entertainment gave additional interest to the evening. The arrangements made were most satisfactory, and we congratulate Mr. Robertson, convener of the Social Events Committee and the hon. treasurer of the Institute, on the success of the evening.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	16/- to 20/6
(1) Spanish	16/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	16/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 12 0	—
No. 1 Foundry	3 16 0	—
No. 3 Foundry	3 13 6	—
N.E. Coast—		
Hematite Mixed Nos.	3 6 6	3 6 6
No. 1	3 7 0	3 7 0
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
Midlands—		
(c) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 6 0	—
„ „ Foundry	3 11 0	—
(c) Northampton—		
Foundry No. 3	3 7 6	—
Forge	3 2 6	—
(c) Derbyshire—		
No. 3 Foundry	3 11 0	—
Forge	3 6 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 1 6 (*a*) / 4 3 6 (*b*) / 4 8 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
Lancs.—		
Crown Bars	10 5 0	—
Second Quality Bars	8 15 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	10 5 0	—
Best Bars	11 0 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	9 12 6 to 10 7 6	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	8 15 0 to 9 0 0	—
Gas Tube Strip	10 17 6 to 11 0 0	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 10 0	10 0 0
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	8 5 0	8 0 0
Sheets (Gal. Cor. 24 B.G.)	11 7 6	11 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
Manchester—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 15 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	9 2 6	—
Sheffield—		
Siemens Acid Billets	9 10 0 (basis)	—
Hard Basic	8 12 6 and 9 2 6	—
Intermediate Basic	7 2 6 and 7 12 6	—
Soft Basic	6 5 0	—
Hoops	10 5 0	—
Soft Wire Rods	7 15 0	—
Midlands—		
Small Rolled Bars	7 0 0 to 8 0 0	—
Billets and Sheet Bars	5 5 0 to 5 15 0	—
Galv. Sheets, f.o.b. L'pool	11 0 0	—
(2) Staffordshire Hoops	9 10 0	—
(d) Angles	8 7 6	—
(d) Joists	8 15 0	—
(d) Tees	9 7 6	—
(d) Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 0 0 to 9 2 6	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14 f.o.b.	15/- to 15/3
Block Tin (cash)	110 17 6
„ (three months)	112 5 0
Copper (cash)	42 11 3
„ (three months)	43 5 0
Spanish Lead (cash)	12 10 0
„ „ (three months)	12 15 0
Spelter (cash)	11 3 9
„ (three months)	11 12 6
Manchester—	
Copper, Best Selected Ingots	45 10 0
„ Electrolytic	46 15 0
„ Strong Sheets	75 0 0
„ Tubes (Basis Price), lb.	0 0 10½
Brass Tubes (Basis Price), lb.	0 0 9½
„ Condenser, lb.	0 0 11½
Lead, English	13 17 6
„ Foreign	12 15 0
Spelter	11 15 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

Tungsten Metal Powder	1/11½ per lb.
Ferro Tungsten	1/8½ per lb.

	Per Ton.	Per Unit.
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 0 0	7/-
„ „ 6 p.c. to 8 p.c.	£19 17 6	7/-
„ „ 8 p.c. to 10 p.c.	£19 12 6	7/-
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£31 0 0	10/-
„ „ „ 1 p.c. carbon	£34 0 0	12/-
„ „ „ 0·70 p.c. carbon	£36 0 0	14/-
„ „ „ carbon free	10d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 0 0 scale 5/- per unit	
„ „ 75 p.c.	£18 0 0 scale 7/- per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£170	
Ferro Cobalt	9/- per lb.	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	14/-
„ „ Ell	14/9
„ „ Splint	14/9 to 16/6
„ „ Trebles	12/-
„ „ Doubles	10/6
„ „ Singles	9/-
Ayrshire—	
(f.o.b. Ports)—Steam	13/-
„ „ Jewel	17/-
„ „ Trebles	12/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	11/6 to 12/3
Screened Navigation	16/6 to 17/6
Trebles	11/6 to 12/6
Doubles	10/6 to 11/-
Singles	9/-
Lothians—	
(f.o.b. Leith)—Best Steam	12/-
Secondary Steam	11/6
Trebles	12/- to 12/6
Doubles	11/-
Singles	9/-

ENGLAND.

(8) N.W. Coast—	
Steams	20/-
Household	30/- to 51/-
Coke	20/- to 20/6
Northumberland—	
Best Steams	13/6 to 14/-
Second Steams	12/- to 12/3
Steam Smalls	10/-
Unscreened	12/6 to 13/-
Household	27/- to 39/-
Durham—	
Best Gas	14/9 to 15/-
Second	13/3 to 13/6
Household	25/- to 37/-
Foundry Coke	26/- to 28/

Sheffield—	Inland.	
Best Hand-picked Branch	25/6 to 27/-	—
Derbyshire Best Bright House	24/- to 26/-	—
Best House Coal	22/- to 23/-	—
Screened House Coal	19/6 to 20/6	—
„ „ Nuts	16/6 to 17/6	—
Yorkshire Hards	15/- to 16/6	—
Derbyshire Hards	15/- to 16/6	—
Rough Slacks	9/- to 10/-	—
Nutty Slacks	7/- to 8/-	—
Smalls	4/6 to 6/6	—

Blast-furnace Coke (Inland) 12/3 on rail at ovens
Furnace and Foundry Coke (Export), f.o.b. 14/- to 15/-

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	20/- to 20/3
Second Smokeless Large	18/9 to 19/9
Best Dry Large	18/6 to 19/6
Ordinary Dry Large	17/9 to 18/-
Best Black Vein Large	18/6 to 18/9
Western Valley Large	18/- to 18/6
Best Eastern Valley Large	18/- to 18/3
Ordinary Eastern Valley Large	17/6 to 17/9
Best Steam Smalls	13/6 to 14/-
Ordinary Smalls	12/- to 13/6
Washed Nuts	18/- to 22/-
No. 3 Rhondda Large	19/9 to 20/3
„ „ Smalls	15/6 to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/- to 36/6
Furnace Coke (Export)	16/6 to 17/6
Patent Fuel	20/6 to 21/-
Pitwood (ex ship)	24/- to 24/3
Swansea—	
Anthracite Coals:	
Best Big Vein Large	35/- to 37/6
Seconds	27/- to 31/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 45/-
Nuts	43/- to 46/-
Beans	24/9 to 28/3
Peas	19/9 to 21/6
Breaker Duff	8/9 to 9/6
Rubbly Culm	8/6 to 9/6
Steam Coals:	
Large	20/6 to 21/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 22/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

International Co-operation.

THE trade depression is deepening so rapidly that no one now believes in the efficacy of temporary measures to enable the country to carry on until the tide changes. The idea that France was in a privileged situation and had nothing to fear has now given way to a certainty that she is bound up with the same problems that beset the rest of the Continent, and that nothing can be done except by close collaboration. How that collaboration can be effected is not yet clear. It certainly cannot be restricted to partial industrial arrangements, which are proving to be quite useless when everyone is anxious to sell and there are few buyers. The negotiations that were continued in Paris last week for the reconstitution of the Steel Cartel again failed to give any definite result. A general scheme of international organisation must be carried out before anything can be done with partial arrangements for particular industries.

Accelerating Transport.

A point of interest at the Lille Fair is the gathering together of representatives of industrial, commercial and other interests, and the conferences and demonstrations which are organised for their benefit. Last week one day was devoted to the visit of engineers, who were entertained with matters relating to the programme of works being carried out in the northern districts, and the Minister of Public Works gave a summary of what was being done. He said that general prosperity could only be attained by enabling consumers to consume more quickly and more cheaply, and one means of accomplishing that end was to cheapen and accelerate communications. This object is being achieved in the Nord and the Pas de Calais by improving and extending the roads and increasing the carrying capacity of the canals which link up the ports with the collieries and allow of direct transport between Dunkirk and the North-West of France. The rivers and canals are being deepened to enable boats drawing 2·2 m. of water to navigate them. Inland ports are being created, notably at Lille and Bethune, and when those works are completed the time occupied by boats in going from Dunkirk to Lille will be reduced by more than one-half. With the aid of German reparations important works have been carried out at Dunkirk, Lille and Calais, and it is intended to complete them under the new national programme. The trouble is that the state of the national finances is retarding the execution of the programme, and it is by no means certain when the works which are being anxiously awaited all over the country will be put in hand.

Rail and Road Traction.

The railway companies complain of the competition of motor vehicles which use the roads with only a very moderate contribution to the cost of construction and maintenance. A considerable quantity of goods is carried by road under conditions of accelerated service and economy that are detrimental to the railways, but it does not necessarily follow that the railways are suffering unduly from this competition. By organising road motor services themselves they have been able to increase the passenger traffic by rail. A case in point is provided by the Paris-Orleans Railway Company, which runs an extensive service of motor vehicles for tourists in the Loire and elsewhere. In 1930 the vehicles carried 36,579 passengers over a total distance of 186,376 kiloms., as compared with 27,938 passengers over a total of 136,935 kiloms. in the previous year. At the same time, the number of passengers on the railway increased from 83,094,844 in 1929 to 84,435,249 in 1930. The State Railways have also extensive motor car services in all the touring districts, and the P.L.M. Company employs motor vehicles for the Alpine routes. The importance of the road motor vehicle as a feeder for the railways is now so fully recognised that the companies are continually developing their road services. They appear now to have settled upon a definite policy with regard to the working of local lines. These lines suffer most from road transport, and rail motors have not done much to save local railways from financial loss. The matter is now being investigated as one phase of the policy of economy which the railway companies intend to carry into effect, and it is probable that many of the local lines will be suppressed and road vehicles run in their stead. The companies are endeavouring to evolve some method of organisation which will identify their interests with those of road and air travel.

Pit Props.

At a time when commercial methods should be adapted to the necessity of keeping foreign trade it is surprising to learn that South Wales coalowners are purchasing large quantities of pit props from Russia because they are cheaper than those obtained from France. One of the reasons why South Wales coal has received preference in this country is that colliers return with pit props, which help to balance trade, and Bordeaux encourages the importation of Cardiff coal because, without it, the trade in pit props would suffer. The French suppliers of props were alarmed some time ago when it was reported that there was a possibility of steel props being substituted for wood in British collieries. Business nowadays can only be done by means of exchange, and there is no more appropriate combination than pit props and coal.

Saint-Malo Harbour Works.

Some important works are being carried out at Saint-Malo for the berthing of steamers from Southampton in connection with the new direct accelerated railway service, known as the Côte d'Emeraude line, between Saint-Malo and the Pyrenees. Representatives of the Southern Railway Company inspected the works last week in company with Monsieur Dautry, general director of the State Railways, and Monsieur Watier, Director of Maritime Ports. The new port will be officially inaugurated on July 1st next, when the service will be started between London and the Pyrenees by way of Southampton and Saint-Malo.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

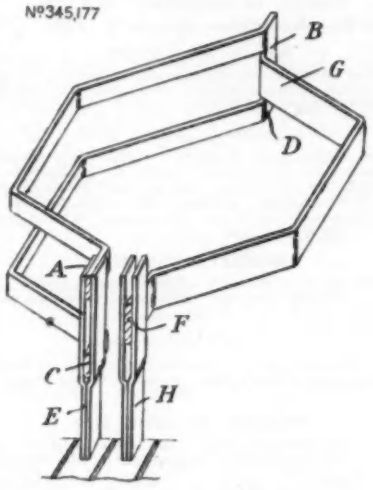
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

345,177. June 25th, 1930.—COMMUTATING DYNAMO-ELECTRIC MACHINES, The English Electric Company, Ltd., of Queen's House, 28, Kingsway, London, W.C. 2; and James Cooper Wilson, of Siemens Works, Stafford.

The object of this invention is to provide means to reduce the self-induction of a coil undergoing commutation, while dispensing with the use of idle copper in the slot. According to the invention, one side of an ordinary two layer winding has its coils each

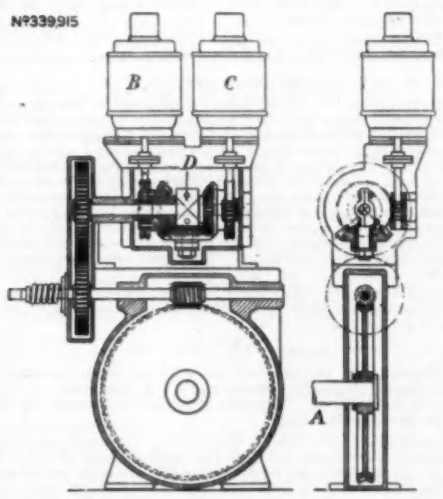


divided into two parallel bars, one of which lies in the top part of the armature slot and the other in the bottom part. A B and C D form the two portions of the one side of the coil, the ends A and C being joined in parallel at the riser E of the commutator. The other side F G of the coil is joined to the commutator riser H at end F and is connected at the rear end G by the joint B D of the two parallel bars. Thus the two parallel conductors A B and C D form a loop A B D C which embraces the slot flux and so provides the damping circuit, part A B lying in the top of the slot and part C D in the bottom.—*March 19th*, 1931.

TRANSMISSION OF POWER.

339,915. April 2nd, 1930.—GEARING FOR DRIVING MECHANICAL STOKERS, H. Römer, 19, Engerstrasse, Düsseldorf, Germany.

This invention is concerned with the adaptation of simple alternating current electric motors to the driving of mechanical stokers, without material electrical loss in the process of regulating the speed. The shaft of the stoker is shown at A and is driven

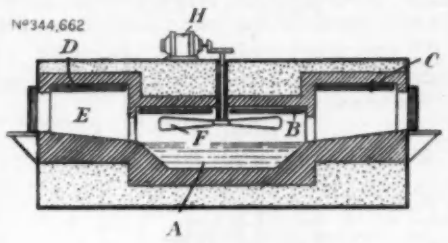


by the two motors B and C through the worm and differential gear shown at D. The two motors have different normal speeds, and the speed of each can be varied by changing the number of poles in action. By the several combinations of the driving effort of these two motors, either in one direction or the other, a reasonable gradation of speed of the driven shaft in the proportion of from 42 to 420 can be attained in nine steps without it being necessary to resort to a rheostat.—*December 18th*, 1930.

FURNACES.

344,662. March 4th, 1930.—ELECTRIC FURNACES COMPRISING A HEARTH AND RESISTANCES ARRANGED ABOVE THE CHARGE, Emil Friedrich Russ, of No. 37, Kaiser-Friedrich-Ufer, Köln-on-the-Rhine, Germany.

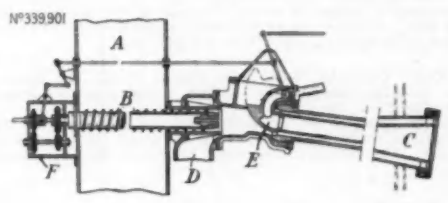
This invention relates to an electric furnace of the type comprising a hearth and resistances arranged above the charge. In electric furnaces of this type a very strong accumulation of heat occurs in the area of the heating bodies, which is liable to injure them and is also detrimental to the heat transition. According to the invention, a device for agitating the air displaces the hot air from the area of the electric heating bodies into the smelting material below. Under the roof of the smelting chamber A an electric heating device B is arranged, and electric heating devices C and D are arranged under the roof of the chamber E. A propeller blade F is arranged under the heating device B in the smelting chamber A and is driven by an electromotor H. The propeller is made either of chromium-nickel or of any other suitable refractory material, such as carborundum.



The propeller throws the hot air out of the area of the heating body B in an axial direction down upon the molten metal in the chamber A, where the hot air spreads out in mushroom form, and flows along the surface of the molten metal, ascending in the chamber E and flowing over the heating bodies C and D to the heating body B, to be acted upon again by the propeller blade and forced to flow in downward direction. It is advantageous periodically to alter the direction of rotation of the electromotor with the aid of an electric time switch.—*March 12th*, 1931.

339,901. March 12th, 1930.—PULVERISED FUEL BURNERS FOR LOCOMOTIVES, R. Roosen, 31, Kaiserplatz, Kassel, Germany.

The object of this invention is to provide a powdered fuel burner which can be quickly adapted to the varying steam requirements of a locomotive. The fuel hopper A is provided with a conveyor screw B, which feeds the powdered coal forward

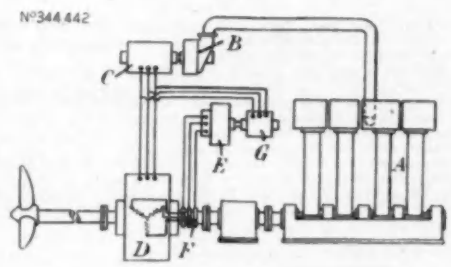


to the burner C. Air is supplied at D. The burner, it will be seen, has two orifices, an annular one and a central one. The central one may be shut off by the rocking gate E, which is hollow and provided with a passage for the supply of cooling air. When the gate is rocked to close the central burner orifice the linkage shown sets the change-speed gear F to slow down the screw conveyor appropriately to the reduced consumption of coal.—*December 18th*, 1930.

SHIPS AND BOATS.

344,442. November 27th, 1929.—SYSTEMS OF SHIP PROPULSION, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2; Reginald Thornton Coe, of 14, Manor-road, Rugby; and Frederick Fitchett, of 25, Lawford-road, Rugby.

This invention relates to systems of ship propulsion of the type in which a reciprocating engine drives the propeller shaft and the exhaust from this engine is utilised to drive a low-pressure turbine directly coupled or geared to an electric generator supplying current to a motor assisting to drive the propeller shaft. In such systems the speed of rotation of the propeller shaft is not uniform, owing to the irregular torque or turning effort of the reciprocating engine, and the invention consists in elec-



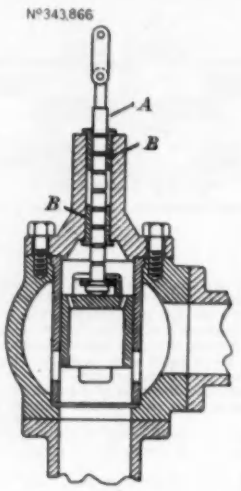
trically connecting a slip regulator in the rotor circuit of the induction motor assisting to drive the propeller shaft. A marine reciprocating engine A which drives the propeller has a number of cylinders through which the steam expands in turn. The steam from the last or low-pressure cylinder is then led to a steam turbine B which drives directly or through gears an electric generator C. Energy from the exhaust steam is thus converted into electrical energy, and this is transferred through electric connections to an electric motor D mounted on or geared to the propeller shaft, which is driven by the main steam engine. A series-excited A.C. commutator motor E is connected through slip rings F to the rotor circuit of the driving motor D and is directly coupled to an A.C. induction generator G connected to feed current to the main supply of the motor D.—*February 27th*, 1931.

MISCELLANEOUS.

343,866. July 28th, 1930.—VALVES FOR HIGH TEMPERATURES, *Associated Electrical Industries, Ltd., Bush House, Aldwych, London, W.C. 2.*

This invention is concerned with stop valves which have to work at high temperatures, and aims at providing a valve stem which needs no lubricant and will not stick. The stem A is made of some corrosion-resisting material, such as stainless steel or Monel metal. The bushes B B are made of Nitralloy, and are nitrided to harden their surfaces. The Nitralloy is a steel containing:—Carbon, 0·20–1·30 per cent.; manganese, 0·40–0·60; phosphorus, 0·025-maximum; sulphur, 0·025-maximum; silicon, 0·50-maximum; nickel, 0·30-maximum; chromium, 0·75–1·50; molybdenum, 0·15–0·25; aluminium, 0·50–1·25 per cent. The nitriding may be carried out by placing the bush in a retort and raising the temperature to between 900 deg. and 1050 deg. Fah. A substance capable of evolving nitrogen, such as ammonia gas, is introduced into the

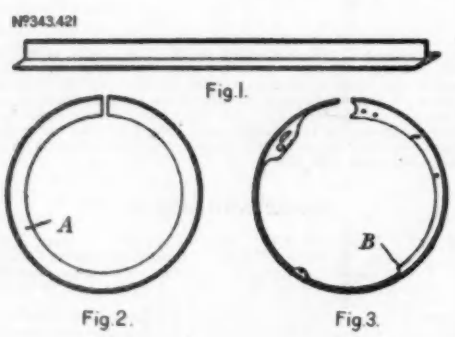
retort for a sufficient length of time for the nitrogen evolved to harden the surface to the required depth. In this manner the surface of the member is rendered resistant to corrosion, and possesses a resistance to frictional abrasion superior to that produced by ordinary case-hardening, and the degree of hardness of



the surface remains unaffected when the temperature is as high as 750 deg. Fah. At this temperature there is no tendency for the metal to temper or soften, as would be the case with case-hardened steel, and therefore there is no tendency for the valve stem to stick in its guide.—*February 26th*, 1931.

343,421. November 14th, 1929.—Brake Shoes, The Midland Steel Products Company, Midison-avenue, and 106th Street, Cleveland, Ohio, U.S.A.

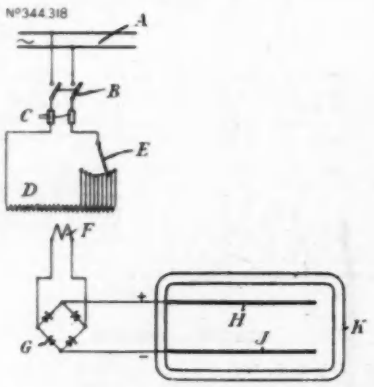
Brake shoes of the expanding type are, according to this invention, made from rolled T-section metal, as indicated in Fig. 1. This section is then rolled to produce the circle shown



in Fig. 2. Finally, the web A, or flange, as it is described in the specification, is sheared off to give the shape shown in Fig. 3. The remains of the web provide for the attachment of the actuating mechanism. It is emphasised that the web should be cut away abruptly at a point such as B, to reduce the tendency of the brake to squeal.—*February 19th*, 1931.

344,318. June 24th, 1930.—Transforming A.C. into Low-tension D.C., Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

Hitherto it has been usual in installations for galvanising to use rotary converters as the source of current, and for the purpose of using the machines more efficiently to connect several baths to one and the same converter. On account of the relatively heavy currents, heavy copper bars have to be used as the conductors, while for the purpose of reducing the bath tension, it is necessary to use for the same reason resistances of large dimensions. The efficiency of such a bath installation is relatively low, on account of the losses in the resistances. As a rule, it



amounts only to 30 to 35 per cent. This invention relates to an installation for the working of electric baths, which eliminates the thick distributing copper bars and the bulky regulating resistances, and at the same time increases the efficiency to a substantial extent. In the drawing, A are A.C. mains connected through a switch B and two fuses C to the primary winding D of a transformer, subdivided into regulating steps, with a regulator E. The secondary winding F supplies a low-tension current to the cells of a rectifier G, which are arranged in Grätz connection. The D.C. terminals of the rectifier are connected directly to electrodes H and J of the tank K. The invention is also applicable to three-phase current.—*March 5th*, 1931.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Chemical Engineering Group.—Waldorf Hotel, Aldwych, London, W.C. 2. Annual general meeting, 6.45 p.m.; dinner, 7.15 p.m. for 7.30 p.m. Address, "Science in Industry," by Sir Richard Gregory.

Institution of Mechanical Engineers.—The presentation of the Sixth Report of the Marine Oil Engine Trials Committee, announced for this date, has been postponed to a date early in next session.

Junior Institution of Engineers.—At the Hotel Metropole, Northumberland-avenue, London, W.C. 2. Annual dinner.

Royal Institution of Great Britain.—21, Albemarle-street, Piccadilly, W. 1. Discourse, "Joseph Priestley and His Place in the History of Science," by Sir Philip Hartog. 9 p.m.

TO-DAY TO SATURDAY, MAY 2ND.

Ideal Home Exhibition.—Olympia, W. Daily.

TO-DAY TO JUNE 30TH.

Science Museum.—South Kensington, S.W. 7. Exhibition of transparancies illustrating the work of the National Physical Laboratory. Open daily.

SATURDAY, APRIL 25TH.

North of England Institute of Mining and Mechanical Engineers.—In the Lecture Theatre of the Institute, Newcastle-on-Tyne. Discussion, "Old Mining Records and Plans," by Mr. T. V. Simpson. Lecture, "Notes on a Recent Visit to South Africa with the Empire Mining and Metallurgical Congress," by Mr. T. C. Futers. 2.30 p.m.

MONDAY, APRIL 27TH.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Howard Lectures, "The Present Position in Aeronautics," by Dr. N. A. V. Piercy. 8 p.m.

TUESDAY, APRIL 28TH.

Staffordshire Iron and Steel Institute.—At the Education Offices, St. James's-road, Dudley. Annual meeting. At 7 p.m.

WEDNESDAY, APRIL 29TH.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. "Stainless Metals," by Professor Sir Harold Carpenter, F.R.S. 8 p.m.

THURSDAY, APRIL 30TH.

Diesel Engine Users Association.—This meeting has been postponed.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, W.C. 2. Presentation of the Faraday Medal to Mr. C. H. Merz. The twenty-second Kelvin Lecture, "The Architecture of Solids," by Professor W. L. Bragg, F.R.S. 6 p.m.

Institution of Locomotive Engineers.—At the Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. "A New and Infinitely Variable Poppet Valve Gear," by Miss V. W. Holmes. 6 p.m.

FRIDAY, MAY 1ST.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, London, S.W. 1. Informal meeting. Discussion on "Hydraulic Valves," to be introduced by Mr. Henry Crowe. 7 p.m.

National Institute of Industrial Psychology.—In the Hall of the Royal Society of Arts, John-street, Adelphi, London, W.C. 2. "The Causes of Juvenile Drifting," by Miss S. Bevington; "*Personnel* Work in Modern Industry," by Mr. A. H. Seymour. 6 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. Annual meeting. 5 p.m.

SATURDAY, MAY 2ND.

Institution of Electrical Engineers: Meter and Instrument Section.—Visit to Cambridge, by invitation from the directors of the Cambridge Instrument Company, Ltd., and Professor C. E. Inglis, F.R.S., of the Engineering Laboratory of Cambridge University. 8.30 a.m., leave Liverpool-street Station; 10.30 a.m., arrive at the works, demonstrations will be arranged by the company; 12.45 p.m., lunch as the guests of the company; 2 p.m., visit places of interest in Cambridge, including some of the colleges, the Backs, and the river; 4.30 p.m., tea at the Engineering Laboratory, Cambridge, by invitation of Professor Inglis, inspect the Laboratory; 7.10 p.m., leave Cambridge by train.

Institution of Municipal and County Engineers.—Eastern District Meeting at Chelmsford. Assemble, County Hotel. 11.30 a.m.

WEDNESDAY, MAY 6TH.

Institute of Metals.—In the Hall of the Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. Annual May Lecture, "Progress of Power Production," by Mr. W. B. Woodhouse. 8 p.m.

Institution of Civil Engineers: Manchester and District Association.—Visit to the cement works of G. and T. Earle (1925), Ltd., at Hope, Derbyshire. Leave Manchester 1 p.m.

WEDNESDAY AND THURSDAY, MAY 6TH AND 7TH.

Institution of Municipal and County Engineers.—Irish Free State District Meeting at 35, Dawson-street, Dublin. 10.30 a.m. daily.

THURSDAY, MAY 7TH.

Iron and Steel Institute.—Grand Hall, Connaught Rooms, Great Queen-street, London, W.C. Annual dinner. 7.30 p.m.

Royal Dublin Society.—Ball's Bridge, Dublin. "Electricity on the Farm," by Mr. R. Borlase Matthews. 2 p.m.

THURSDAY AND FRIDAY, MAY 7TH AND 8TH.

Iron and Steel Institute.—At the Institution of Civil Engineers, Great George-street, Westminster, S.W. 1. Annual meetings. 10 a.m. each day. For programme see page 440.

FRIDAY, MAY 8TH.

Institution of Electrical Engineers.—The Foresters' Hall, Nicol-street, Dundee. Faraday Lecture, "The Birth of Electrical Engineering," by Professor W. Cramp. 7.30 p.m.

Royal Institution of Great Britain.—21 Albemarle-street, Piccadilly, W. 1. Discourse, "The Measurement of Noise," by Dr. G. W. C. Kaye. 9 p.m.

MONDAY, MAY 11TH.

Iron and Steel Institute.—At the Cleveland Technical Institute, Corporation-road, Middlesbrough. "Production Economy in Iron and Steel Works," by Mr. O. Cromberg; "The Melting Shop of the Appleby Iron Company, Ltd.," by Mr. A. Robinson. 7.30 p.m.

THURSDAY, MAY 14TH.

Iron and Steel Institute.—At the Birmingham Chamber of Commerce, 95, New-street, Birmingham. "First Report on the Corrosion of Iron and Steel," being a report by a Joint Committee of the Iron and Steel Institute and the National Federation of Iron and Steel Manufacturers to the Iron and Steel Industrial Research Council; "Production Economy in Iron and Steel Works," by Mr. O. Cromberg; "On the Nature of Defective Laminations in Wrought Iron Bars and Chain Links," by Mr. H. J. Gough and Mr. A. J. Murphy; "The Melting Shop of the Appleby Iron Company, Ltd.," by Mr. A. Robinson. 7 p.m.

FRIDAY, MAY 15TH.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. Discourse, "Experimental Aspects of Hydrogen-Ion Concentration," by Dr. J. C. Philip, F.R.S. 9 p.m.

SATURDAY, MAY 16TH.

Institution of Municipal and County Engineers.—Southern District Meeting at Cheltenham. Assemble Town Hall at 10.30 a.m.

FRIDAY, MAY 22ND.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. Discourse, "X-ray Investigations of the Structure of Liquids," by Sir William Bragg, F.R.S. 9 p.m.

SATURDAY TO SUNDAY, MAY 30TH TO JUNE 14TH.

Institute of Transport.—Italian Tour and Congress. For provisional programme see page 359.

MONDAY TO FRIDAY, JUNE 1ST TO 5TH.

International Federation for Housing and Town Planning.—Berlin. Thirteenth International Housing and Town Planning Congress.

WEDNESDAY, JUNE 24TH.

Staffordshire Iron and Steel Institute.—Annual excursion. Visit to the National Physical Laboratory, Teddington.

MONDAY TO SATURDAY, JULY 13TH TO 18TH.

Society of Chemical Industry.—Jubilee Celebrations. For provisional programme see page 471.

CONTRACTS.

Messrs. Midgley and Sutcliffe, of Bradford, have received an order from the Admiralty for some "Richmond" new design all-geared milling machines.

The British Thomson-Houston Company, Ltd., has received a contract for a three months' supply of Mazda vacuum and gas-filled lamps from the Port of London Authority.

Crossley Brothers, Ltd., Manchester, has received an order from the British Broadcasting Corporation for four 350 B.H.P. vertical oil engines for the new Scottish Regional Station at Falkirk.

Ruston and Hornsby, Ltd., of Lincoln, has supplied engines for the power plant at the Northern Regional Transmitting Station at Moorside Edge of the British Broadcasting Corporation.

The General Electric Company, Ltd., has been awarded the contract for the complete equipment of four traction sub-stations for the London Electric Railway Company, at Sudbury Hill, Alperton, North Ealing and Northfields. The equipment comprises a total of ten 1500-kW remote-controlled mercury arc rectifiers, operating from an 11,000-volt, three-phase supply and feeding the traction system at 630 volts D.C., together with the whole of the automatic control gear, air blast transformers, high-speed circuit breakers, cabling, lighting, &c.

The Great Western Railway Company has just placed the following contacts:—(*a*) Widening the main line between Filton Junction and Stapleton-road, Bristol, 2¼ miles, Messrs. Ernest C. Jordan and Son, Newport; (*b*) extensions of Bristol, Temple Heads goods shed roof and verandah, John Lysaght, Ltd., Bristol; (*c*) extensions of the general offices, Paddington Station, Holliday and Greenwood, Ltd.; (*d*) carriage shed at Canton, Cardiff, Cardiff General Station alteration, B. Hinde and Co., Ltd., Swansea; (*e*) automatic and manual telephone exchange at Cardiff, Queen-street Station, Ericsson Telephone, Ltd., Kingsway, London; (*f*) reconstruction and widening of bridges between Newtown Yard and Cardiff General Station; John Morgan (Builders), Ltd., Cardiff; (*g*) supply and erection of a steel viaduct to No. 6 hoist, West Side, East Dock, Cardiff Docks, A. D. Dawnay and Sons, Ltd., Cardiff; (*h*) new engine shed and lifting shop and other works at Landore, Swansea, Messrs. F. Halcombe and Sons, Cardiff; (*i*) two reinforced concrete jetties each to carry a new coal hoist at Port Talbot docks, Messrs. Christiani and Nielsen, London; (*j*) construction of cattle pens, weighbridge, retaining walls, roadways, and other works at Taunton Station, R. Wilkins and Sons, Ltd., Bristol; (*k*) fifteen Powers-Samas accounting machines and equipment for Chief Mechanical Engineer's Office, Swindon, Powers-Samas Accounting Machines, Ltd., Birmingham; (*l*) reconstruction of platform coverings at Vine-street Station, Uxbridge, Geo. Sands and Co., Ltd., Colwick; (*m*) overhaul of twin-screw steamer "St. Helier," J. I. Thornycroft and Co., Ltd., London; (*n*) supply and erection of two electrically driven air compressors for new concentration yard, Swindon, Bellies and Morcom, Ltd., Birmingham; (*o*) overhaul of twin-screw steamer "Great Southern," Thomas Diamond and Co., Ltd., Cardiff; (*p*) accommodation under approach arches at Paddington Goods Station, Holliday and Greenwood, Ltd., London; (*q*) repairing roof of Old Warehouse at South Lambeth Depôt, Edward Proctor and Sons, Ltd.; (*r*) construction of reinforced concrete engine pit at Canton Carriage Shed, Cardiff, Christiani and Nielsen, London; (*s*) erection of a detached house for station-master, St. David's-hill, Exeter, F. A. Bridges and Son, Exeter; (*t*) two 6-ton hand travelling cranes for Newport and Reading, Bedford Engineering Company, Bedford; (*u*) supply and erection of manual and automatic telephone exchange, Wolverhampton, Ericsson Telephones, Ltd., London; (*v*) supply and erection of steel-framed warehouses at Shrivenham and Wootton Bassett, T. Partridge and Co., Ltd., Walsall; (*w*) extensions of verandah covering to goods warehouses at Connaught-road Depôt, Royal Albert Dock, Frederick Braby and Co., Ltd., London; (*x*) repairing roads and laying concrete kerb at G.W.R. Park Royal Trading Estate, Mr. Hiram Morecroft, Acton; (*y*) provision and installation of 24-volt C.B. telephone exchange equipment at the G.W.R. Royal Hotel, Paddington, Ericsson Telephones, Ltd., London; (*z*) supply and erection of a steel-framed warehouse at Trowbridge, Croggan and Co., Ltd., London; (i.) supply and delivery of five Ford 30-cwt. tipping trucks at Theale and twelve Fordson tractors for general use, Messrs. R. Pratt and Co., Sutton, Surrey; and (ii.) five Cob tractors for experimental use at Paddington goods, Karrier Motors, Ltd., London.